**5k Fun Run**

*Miscellaneous*

**Tue, Dec 2 6:30 AM - 7:30 AM**  
**Location: Arvey Field**

**ABSTRACT**

Join us for the RSNA 2014 5k Fun Run and help the RSNA RandE Foundation keep our specialty at the forefront of healthcare. Whether you run or walk enjoy an outing for a good cause with your colleagues along Chicago’s beautiful Lake Michigan shore. Your fully tax-deductible donation will benefit the RSNA RandE Foundation. Participants will receive commemorative T-shirt, while supplies last. Please note, in case of inclement weather, the Fun Run may be cancelled. All Fun Run fees are non-refundable and non-transferable.

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**SPDL31**

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

*Special Courses*

| NR | MK | HN | CA |

AMA PRA Category 1 Credits ™: 1.00  
ARRT Category A+ Credit: 0  
**Tue, Dec 2 7:15 AM - 8:15 AM**  
**Location: E451B**

**Participants**

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

**LEARNING OBJECTIVES**

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

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**SPSC30**

**Controversy Session: Head and Neck Modality Roulette: What's the Best Imaging Option?**

*Special Courses*

| NM | MR | CT | NR | HN |

AMA PRA Category 1 Credits ™: 1.00  
ARRT Category A+ Credit: 1.00  
**Tue, Dec 2 7:15 AM - 8:15 AM**  
**Location: E451A**

**Participants**

- Moderator: Deborah Rachelle Shatzkes MD : Nothing to Disclose

**Sub-Events**

**SPSC30A**

**4DCT in Parathyroid Adenoma Search: Is It Worth the Dose?**

- C. Douglas Phillips MD (Presenter): Stockholder, MedSolutions, Inc Consultant, Guerbet SA, Laurie A. Loever MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

We will discuss the contribution of 4D-CT to imaging parathyroid adenomas and parathyroid hyperplasia and whether or not the technique is of value in the current radiation-conscious era.

**ABSTRACT**

A physician wishing to accurately diagnose and localize parathyroid tissue for minimally invasive parathyroid surgery (MIPS) has a number of potential choices. They may choose to not image the patient. They may utilize Tc-99m SESTAMIBI imaging with or without SPECT or CT fusion, they may order US, MRI, or CT studies. 4D-CT has gained attention as an accurate and reliable test to localize parathyroid tissue for MIPS. The questions regarding this technique are 1) does it answer the question reliably? and 2) is it worth the dose to an individual patient?
Surveillance Imaging in Head and Neck Cancer: Should PET/CT be the First-line Modality?

LEARNING OBJECTIVES

1) List 3 advantages to using PET/CT for surveillance of treated Head and Neck Squamous Cell Carcinoma. 2) List 3 disadvantages to using PET/CT for surveillance of treated Head and Neck Squamous Cell Carcinoma. 3) Describe the optimal frequency and duration of PET/CT for surveillance of treated Head and Neck Squamous Cell Carcinoma.

ABSTRACT

In patients with head and neck squamous cell carcinomas, PET/CT has proved useful at several different stages of patient care. PET/CT is used for staging a newly-discovered malignancy (or re-staging of recurrence); it is used to monitor response to therapy; it is used to assess suspicious signs and symptoms in treated patients; and it is used for surveillance of treated patients who have no evidence of residual disease. The appropriate application of PET/CT in these clinical scenarios is controversial. Some of the advantages and disadvantages of PET/CT for surveillance are undisputed, but the details of how to apply the technique have not been fully optimized in the current radiology literature. In this presentation, advantages and disadvantages of surveillance PET/CT (relative to CT) are described, and areas of controversy and ongoing research are delineated.

MRI of the IAC: Do We Need Gadolinium?

LEARNING OBJECTIVES

1) the various MR high resolution techniques for imaging the internal auditory canal. 2) the evidence supporting the use of contrast material with MR imaging in the evaluation of hearing loss. 3) the evidence supporting the use of non contrast MR imaging in the evaluation of hearing loss.

ABSTRACT

This presentation will highlight the evidence in favor and opposed to the use of gadolinium contrast administration in the setting of hearing loss from suspected vestibular schwannoma. Authors will demonstrate the use of high resolution non contrast MRI techniques tailored to the IAC, and show case examples where the use of gadolinium is useful in detecting diseases other than schwannoma.
MR-guided Focused Ultrasound Treatment of Painful Bone Metastases

David C. Gianfelice MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Introduce technology of MR Guided focused ultrasound ablation 2) Specific application of this technology for painful bone metastases 3) Review of the literature and definitive Phase 3 study 4) Possible future applications

Special Interest Session: Radiology Preparedness and Ebola Virus Disease

Special Courses

Tue, Dec 2 7:15 AM - 8:15 AM  Location: E352

LEARNING OBJECTIVES

1) Identify the current CDC and other guidelines relevant to radiology practices. 2) Examine the US approach to diagnosis and treatment of Ebola Virus Disease. 3) Appraise a unified approach to considerations involved in medical imaging in patients with Ebola Virus Disease.

ABSTRACT

The unprecedented Ebola outbreak in West Africa - concentrated in Liberia, Sierra Leone, and Guinea - has already claimed nearly 4900 lives as a result of high case mortality rate of more than 70%. Over the past three months, the first US patients with Ebola Virus Disease (EVD) have been effectively treated in several facilities, including Emory University Hospital and the National Institutes of Health. In this Special Interest Session, we address the imperative to rapidly develop and disseminate standard operating procedures for point-of-care imaging procedures. Given that Radiology facilities may be key entry points for the evaluation of outpatients and emergency department patients, effective screening and isolation procedures are essential.

Sub-Events

SPSI31A  Welcome and Introduction of Speakers

Carolyn C. Meltzer MD (Presenter): Board of Directors, ACR Image Metrix

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSI31B  Ebola in the US: Lessons Learned

Bruce Ribner MD, MPH (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSI31C  Medical Imaging and Ebola Virus Disease: SOPs

David A. Bluemke MD, PhD (Presenter): Research support, Siemens AG

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSI31D  Medical Imaging and Ebola Virus Disease: Education and Communication

Carolyn C. Meltzer MD (Presenter): Board of Directors, ACR Image Metrix

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, which gives attendees a chance to try their hand at diagnosis using only "vintage" images. Attendees will also have an opportunity to view striking images in the Art and Science gallery and contribute their favorite RSNA memories or celebratory messages in the Memory Book. The Centennial Showcase will be open: November 29, 12:00pm-5:00pm November 30 - December 4, 7:30am-6:00pm December 5, 7:30am-12:30pm

MSAS31
Managing Health Care: Imaging Utilization—An International Perspective (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Multisession Courses

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

Tue, Dec 2 8:30 AM - 10:00 AM  Location: S105AB

Participants
Moderator
Alexander Yule DSc: Nothing to Disclose
Richard Evans (Presenter): Nothing to Disclose
David Collier (Presenter): Nothing to Disclose
Salvatore Martino (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Delegates will be able to compare current management and clinical issues for radiology services in three contrasting health care systems.

MSCC31
Case-based Review of Nuclear Medicine: PET/CT Workshop—Head and Neck Cancers (In Conjunction with SNMMI) (An Interactive Session)

Multisession Courses

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

Tue, Dec 2 8:30 AM - 10:00 AM  Location: S406A

Participants
Rathan M. Subramaniam MD, PhD (Presenter): Speakers Bureau, Eli Lilly and Company

LEARNING OBJECTIVES
1) To understand the value of PET/CT in the care process of managing head and neck cancer. 2) To review illustrative cases and pitfalls of interpretation.

MSES31
Essentials of Non-interperative Skills

Multisession Courses

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

Tue, Dec 2 8:30 AM - 10:00 AM  Location: S100AB

LEARNING OBJECTIVES
1) Understand the history, current administration and future directions of the Medicare program and how it impacts radiologists. 2) Understand their role in influencing Medicare policy to the benefit of our patients.

Sub-Events
MSES31A What Every Radiologist Needs to Know about Medicare
Geraldine B. McGinty MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the history, current administration and future directions of the Medicare program and how it impacts radiologists. 2) Understand their role in influencing Medicare policy to the benefit of our patients.

MSES31B Intravenous Contrast Media
LEARNING OBJECTIVES

1) Understand the current thinking regarding risk of contrast-induced acute kidney injury from intravenously administered iodinated contrast media. 2) Learn the recent updates to the American College of Radiology’s Manual on Contrast Media. 3) Remember the correct dose of epinephrine for the treatment of anaphylaxis.

ABSTRACT

Recent changes to the ACR Manual on Contrast Media will be reviewed, with an emphasis on contrast-induced acute kidney injury. Other topics, including gadolinium-based contrast media-related complications, external warming of iodinated contrast media, and management of acute contrast reactions will be reviewed.

LEARNING OBJECTIVES

1) Understand the basic definition of quality and how it is applied in practice. 2) Understand how quality improvement principles developed in service and manufacturing are relevant to radiology. 3) Be familiar with basic improvement strategies that can be applied in a local radiology practice.

LEARNING OBJECTIVES

1) The learner should be able to explain the elements of professionalism as they apply to the practice of radiology. 2) Attendees should be able to use available resources to comply with the requirements of professionalism. 3) Attendees will be able to choose appropriate courses of action that apply to solving issues related to lapses in professional behavior. 4) The learner will gain ability to articulate how professionalism can impact the quality of patient care. 5) The learner will be able to devise appropriate goals for professionalism within their practice.

LEARNING OBJECTIVES

1) Describe what the Lean approach is and how this can be implemented in a Radiology department. 2) Describe the fundamental principles of the Lean approach as they apply to the field of imaging. 3) Discuss why the current practice of radiology is well-suited to the Lean approach. 4) Give examples of how the Lean approach can be used in an imaging environment. (This course is part of the Quality Improvement Symposium)
LEARNING OBJECTIVES
View learning objectives under main course title. (This course is part of the Quality Improvement Symposium)

**MSQI31**

**Applying Lean Process Improvement Methods for Radiology Workplace Design**
Paul Martin Knechtges MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title. (This course is part of the Quality Improvement Symposium)

**BOOST: Head and Neck—Oncology Anatomy (An Interactive Session)**

**Multisession Courses**

**MSRO31**

**Imaging of Nasopharynx Cancer**
Suresh K. Mukherji MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Review the normal anatomy of the nasopharynx. 2) Discuss the relationship between staging and imaging. 3) Describe common spread patterns of nasopharyngeal carcinoma.

ABSTRACT
This session will review the normal anatomy of the nasopharynx. We will also discuss the important relationship between imaging and staging.

**Contouring based on Patterns of Spread for Nasopharynx Cancer**
Sung Kim MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Learn the patterns of spread of nasopharyngeal cancer, and how to contour accordingly

**Common Pathways of Perineural Spread**
Suresh K. Mukherji MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Describe common pathways of perineural spread. 2) Review the imaging findings of perineural spread. 3) Describe the proper imaging technique for being able to detect perineural spread.

ABSTRACT
This session will be a detailed review of the normal anatomy of the pathways of perineural spread. This will focus on the normal anatomy, imaging appearance of perineural spread and techniques for optimal imaging.

**Perineural Spread and Implications for Radiation Oncology**
Sung Kim MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Learn about indications and contouring for perineural invasion.
MSRO34

BOOST: Gynecology—Oncology Anatomy (An Interactive Session)

Multisession Courses

**Participants**

- Paul Martin Knechtges MD (Presenter): Nothing to Disclose
- Mark David Hohenwalter MD (Presenter): Nothing to Disclose
- Beth A. Erickson MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the radiologic features of female gynecologic cancers for both intact and post-operative presentations. 2) Review the radiologic features of female gynecologic cancers before, during and after external beam irradiation and brachytherapy. 3) Review the recommended external beam and brachytherapy contouring guidelines for intact and post operative gynecologic cancer presentations.

**ABSTRACT**

The treatment of gynecologic cancers with radiation as a component of treatment requires a clear understanding of the imaging characteristics of disease before and after radiation. Knowledge of the patterns of cancer spread, both locally and regionally, is important in designing radiation treatment plans which may include external beam and/or brachytherapy. Proper contouring of radiation targets and organs at risk is essential in developing treatment plans which maximize the benefits and minimize the risks of radiation, both for external beam and brachytherapy. The subsequent follow up of patients with imaging after radiation is also important in helping to identify recurrent disease and complications. Radiation oncologists and radiologists working in collaboration can enhance the care of these patients before, during and after treatment.

RC302

Strategies for ABR Core Exam and ACGME Program Requirements

**Participants**

- Moderator: Lori A. Deitte MD

**Sub-Events**

**RC302A**

The ABR Core Exam: An Update on Strategies That Work

Christopher Stephens MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe core exam preparation resources and better understand which resources are more effective. 2) Delineate alternative ways to prepare for the core exam during the first three years of residency. 3) Discuss successful strategies for the core exam physics preparation including the timing of the various components of the physics curriculum.

**ABSTRACT**

Two cycles of the new ABR Core Exam have now been completed. With so many resources available, trainees may feel overwhelmed by options on how to prepare for this exam. This session will discuss various successful preparation strategies utilized by residents who recently took the exam. The session will also discuss curriculum strategies for faculty preparing their residents for the exam.

**RC302B**

Beyond the Differential Diagnosis! Strategies for Physics Preparation for the Core Exam

J. Anthony Seibert PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the physics components of the ABR Core exam. 2) Discuss the methods of creating and vetting a physics question from a medical physicist perspective. 3) Explain effective methods of preparing for medical physics content.
ABSTRACT

Physics represents the largest percentage of questions in the Core Exam, with representative questions in each column of the grid on basic medical physics, underlying principles of medical physics applicable to the specific area of radiology, safety, effective use, and artifacts. Continuously using medical physics understanding and principles in routine practice throughout the residency will be the best preparation for the exam, but supplemental use of additional resources such as the RSNA/AAPM physics modules is discussed.

Evaluating Resident and Fellow Progress through the Clinical Competency Committee: Practical Tips on Planning and Moderating an Effective CCC Meeting

Lori A. Deitte MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss strategies for planning and conducting an efficient and effective Clinical Competency Committee meeting. 2) Describe practical approaches for assessing and documenting milestone progress by the Clinical Competency Committee.

ABSTRACT

The Accreditation Council for Graduate Medical Education implemented a phased rollout of the Next Accreditation System starting in July 2013. This new accreditation process requires all graduate medical education programs to appoint a Clinical Competency Committee. The purpose of this committee is to help program directors determine the progress of residents and fellows in their programs and to identify trainees who may benefit from early intervention. Preliminary experiences with planning and conducting Clinical Competency Committee meetings will be presented, along with strategies for streamlining this process. Practical ideas for assessing and documenting milestone progress by the Clinical Competency Committee will also be discussed.

Adult Structural and Congenital Heart Disease (An Interactive Session)

Refresher/Informatics

LEARNING OBJECTIVES

1) To understand the systematic segmental approach to congenital heart disease. 2) To recognize the CT specific imaging findings that relate to each step in the segmental approach to congenital heart disease.

Tailoring CT Scan Acquisitions to Specific Indications

Brian Burns Ghoshhajra MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the different indications for cardiac CT, including calcium scoring, coronary CT angiography, electrophysiology procedural planning, structural heart disease interventions (including TAVR), congenital heart disease, myocardial evaluation, and mass workup. 2) To review the differences between various available equipment, and how available equipment might affect a given protocol. 3) To review basic protocols for each of the above exam types, and review specific features of each exam type. 4) To review the advantages and disadvantages of individualized settings within each of the above protocols.

Imaging of Cardiac Shunts

Harold Ira Litt MD, PhD (Presenter): Research Grant, Siemens AG Research Grant, Heartflow, Inc

LEARNING OBJECTIVES

1) Describe MR imaging methods for detection and quantification of intra and extracardiac shunts. 2) Describe CT imaging methods for detection and quantification of intra and extracardiac shunts. 3) Plan an optimized protocol for CT or MR imaging of shunts.
Role of MRI in Adult CHD Management

Gautham P. Reddy MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the indications for MRI in the management of adults with congenital heart disease. 2) To discuss the advantages and drawbacks of MRI performed to assess morphology and function. 3) To compare the role of MRI to other imaging modalities. 4) To review imaging of specific anomalies such as tetralogy of Fallot, coarctation of the aorta, transposition of the great arteries, and single ventricle physiology.

Alzheimer's Disease

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.00
Tue, Dec 2 8:30 AM - 10:00 AM Location: N227AB

Participants

Moderator

Sub-Events

RC305A Neurobiology and Imaging Research in Alzheimer's Disease

Sterling Johnson PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To gain a broad overview of the disease symptom picture of AD and its associated neuropathology and imaging features. 2) To review the cognitive and biomarker profiles in AD and discuss ways that new research may inform the clinical diagnosis. 3) To gain an overview of the research being done in the presymptomatic phase of AD including emerging neuroimaging and biomarkers changes that occur prior to overt symptom onset.

ABSTRACT

Alzheimer's Disease (AD) is the disease of our time. It affects over 35 million worldwide, and the numbers will rise as society ages. The health care costs of AD are staggering. While other common causes of death in the elderly are declining, AD is increasing. This symposium will provide an overview of the disease from multiple angles and discuss insights gained from the latest advances in research on its neurobiology and early diagnosis.

RC305B Pathologic Correlates of Dementia Imaging

Julie A. Schneider MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Apply the concept of mixed pathologies to the clinical diagnosis of persons with dementia. 2) Describe the range of cerebral infarct pathology in the brain. 3) Describe dementia-related pathologies that are visible and not currently visible by conventional neuroimaging.

RC305C Multimodal Amyloid Imaging

Mykol Larvie MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand current evidence regarding the amyloid hypothesis with respect to Alzheimer's disease. 2) Understand the major Alzheimer's disease syndromes, including early onset AD, late onset AD and AD related to specific mutations. 3) Understand the concept and development of amyloid PET imaging radiotracers. 4) Understand the application of amyloid PET imaging in the evaluation of neurodegenerative disease. 5) Understand the principles of interpretation of amyloid PET imaging. 6) Understand the correlation of amyloid PET imaging with multi-modal MRI and FDG PET imaging.

Active Handout

**Sub-Events**

**RC306A  Sinonasal Inflammatory Disease**  
Christine M. Glastonbury MBBS (Presenter): Investor, Amirsys, Inc

**LEARNING OBJECTIVES**

1) Review the imaging features of sinonasal (SN) inflammatory disease starting with acute and chronic rhinosinusitis. 2) Understand the pathogenesis and imaging manifestations of critical complications of these processes. 3) Learn the key distinguishing features that indicate more aggressive SN processes such as invasive fungal sinusitis, granulomatous disease and SN malignancy.

**RC306B  Sinonasal Tumors**  
Hilda Elie Stambuk MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the imaging features of benign and malignant sinonasal tumors. 2) Understand the role and specific utility of imaging modalities in the diagnosis of sinonasal tumors. 3) Learn the imaging characteristics of pathways of spread of malignant sinonasal tumors. 4) Understand important imaging features relevant to treatment and post-treatment surveillance of sinonasal tumors.

**ABSTRACT**

Tumors of the paranasal sinuses and nasal cavity are rare, constituting only about 3% of all upper respiratory tract tumors. The majority of patients present with non-specific symptoms and radiologists are often challenged to make the clinician aware of the potential for an ominous disease process such as a malignant tumor. It is therefore crucial to understand the role of imaging modalities such as CT, MRI and PET scan in order to optimize the benefits of imaging against the risks of misdiagnosis. Contrast-enhanced CT in axial and coronal planes is an excellent initial study for evaluation of sinus neoplasms because bone destruction is more easily seen on CT. Ear-ily stage tumors present as unilateral masses that generally do not densely enhance on CT. Bony destruction is a common feature of squamous cell carcinoma (SCC), whereas regressive remodeling of adjacent bone occurs more frequently in benign and less aggressive lesions. Most tumors have low to intermediate signals on T1W MRI. Because they generally are highly cellular with little water content, they have intermediate signal on T2W images and are therefore easy to differ-entiate from postobstructive sinus secretions, which are hyperintense on T2W MRI. Some minor salivary gland tumors, schwannomas, and inverted papillomas have sufficient water content and can be bright on T2W MRI. Postcontrast T1W MRI is particularly important in iden-tifying dural/intracranial extension of tumors. PET scan is the first-line modality in monitoring patients after therapy because of very high negative predictive value. False-positive results can however occur because of infection, inflammation, and early treatment-related changes that take up to 3 months to resolve. This lecture will discuss the salient features of common benign sinonasal tumors and illustrate the anatomic patterns of spread for malignant tumors including perineural spread.

**RC306C  Orbital Differential Diagnosis**  
Jenny K. Hoang MBBS (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To apply a systematic approach to orbital masses. 2) Provide differentials for orbital masses based on location. 3) Appreciate overlapping imaging findings of orbital pathologies. 4) Recognize characteristic clinical and imaging features of orbital pathologies.
Participants
Mindy Meislich Horrow MD (Presenter): Spouse, Director, Merck & Co, Inc
Paula J. Woodward MD (Presenter): President, Amirsys, Inc

LEARNING OBJECTIVES
1) The learner will be made aware of the importance of acute kidney injury (AKI) and associated ultrasound findings. 2) Ultrasound criteria of cystic adnexal masses will be reviewed. 3) Testicular and scrotal pathology and the importance of ultrasound will be explained.

ABSTRACT
Ultrasound has taken on new importance in the evaluation of the kidney, female pelvis and the scrotum/testicles. We will explain the ultrasound findings of acute kidney injury (AKI), the evaluation of pelvic masses and the necessary follow-up. Finally, a review of the testicle and ultrasound findings will complete the course.

RC308
Emergency Imaging in Vulnerable Populations—Considerations and Calibrations

Sub-Events
RC308A The Obese Patient
Martin Lee David Gunn MBChB (Presenter): Medical Advisor, TransformativeMed, Inc Spouse, Consultant, Wolters Kluwer nv Grant, Koninklijke Philips NV

LEARNING OBJECTIVES
1) Identify logistical and image quality challenges when obese patients are imaged in the Emergency Department. 2) Recognize common CT imaging artifacts in the obese patient. 3) Develop techniques to optimize image quality for obese ED patients when radiography, ultrasound and CT are used. 4) Understand current concepts about CT radiation dose in obese patients.

URL's
http://depts.washington.edu/uwerad/education.html

RC308B The Transferred Patient
Joel A. Gross MD, MS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the advantages of utilizing outside images for transferred patients. 2) Recognize the challenges in obtaining, processing, loading, and storing these images locally. 3) Recognize the challenges in managing the outside interpretations provided, and/or (re)interpreting the studies locally.

ABSTRACT
Over the past decade, the number of transferred patients arriving in emergency departments with outside imaging has increased tremendously, due to the relative ease and lowered costs of providing multiple images on small and inexpensive CD/DVDs, or via electronic transfers. This provides a tremendous opportunity to improve patient care, potentially allowing a trauma team to know what injuries the patient has suffered before they arrive, and reducing the added time, radiation, contrast and cost of re-imaging a patient. Unfortunately, this opportunity also presents with numerous challenges, including: additional time to obtain and process outside images; complexity of reviewing images obtained with different protocols from those used at the reviewer’s institution, incomplete studies, lesser quality studies than those obtained locally. In addition, decisions have to made regarding the processing and interpretation (if any) of these studies.

RC308C The Pediatric Patient
Susan D. John MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Recognize the special challenges and risks of medical imaging in pediatric patients. 2) Evaluate the risks and benefits of various imaging modalities for specific pediatric diagnoses. 3) Design imaging procedures that are
tailored to the special needs of the infant, young child, and adolescent patient.

**The Geriatric Patient**

Claudia Theresa Sadro MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Epidemiology of geriatric trauma. 2) Imaging protocols for the geriatric patient who sustains minor and major trauma including the value of CT, when to order MRI and thresholds for angiography. 3) Guidelines for measuring renal dysfunction and giving intravenous iodinated contrast in the setting of renal dysfunction in geriatric patients. 4) Unique patterns of injury encountered in geriatric patients will be shown with clinical examples including head trauma, spine trauma, rib fractures and chest trauma, abdominal trauma, pelvic fractures and extremity fractures. Special attention will be made to traumatic injury in patients on anticoagulants, steroids and bisphosphonates. 5) Pre-existing medical conditions and incidentalomas in geriatric patients. 6) Prevention of geriatric trauma.

**ABSTRACT**

The geriatric population is the most rapidly growing sector of the US population, and emergency departments are seeing an increasing number of geriatric trauma patients. Geriatric patients are at risk for serious injuries following relatively minor trauma. Underestimation of their injuries based on mechanism of action by caregivers and health care personnel is a significant cause of morbidity and mortality in this age group. Radiology plays an important role in the early work up of these patients. CT is the mainstay of imaging. There is less concern about the risk of cancer from ionizing radiation in this age group. Intravenous contrast may be administered in patients with normal renal function. In patients with impaired renal function, it is important to follow guidelines appropriate for age. Geriatric patients have different injury patterns than younger patients and are at increased risk of serious complications from minor injuries. They require early diagnosis and aggressive intervention to decrease mortality and to enable them to return to independent living. This review will discuss head injury, spine injury, rib fractures, blunt abdominal trauma, pelvic fractures, extremity fractures and pre-existing illness as it pertains to radiology in the geriatric population.
LEARNING OBJECTIVES

1) Determine chorionicity and amnionicity and understand why it is important to do so in all multiple gestations.
2) Understand and diagnose specific complications of monochorionic twinning such as twin to twin transfusion
syndrome and twin reversed arterial perfusion. 3) Recognize the indications for more frequent surveillance and
intervention in complicated twin pregnancies.

ABSTRACT

This lecture will review how to determine chorionicity and amnionicity with emphasis on doing so in the first
trimester. Monochorionic pregnancies require increased surveillance because of specific complications relating to
shared placental vasculature. We will review the imaging findings of twin to twin transfusion syndrome and twin
reverse arterial perfusion sequence as the prognosis is very poor if untreated. Early recognition and prompt
referral is essential for pregnancy management.

Active Handout


RC310C

Obstetrical Emergencies

Carol Beer Benson MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Diagnose and differentiate causes of bleeding in pregnancy based on sonographic findings. 2) Apply
transvaginal and translabial techniques to assess the cervix and placenta. 3) Use ultrasound to diagnose
causes of pain in pregnancy. 4) Recognize the sonographic appearance of uterine incarceration during
pregnancy and its clinical significance. 5) Understand how to interpret fetal umbilical artery Doppler in the
assessment of fetal well-being.

ABSTRACT

This lecture will discuss how ultrasound is used to assess acute problems in pregnancy during the second and
third trimesters, including symptoms of pain and bleeding, abnormal findings at physical examination, and
concerns for fetal well-being. Techniques for assessing cervical length and placenta previa will be discussed,
including transvaginal and translabial scanning. Also included will be a discussion about when and how to use
fetal umbilical artery Doppler for assessing fetal well-being. Sonographic assessment of abnormal fetal heart
rate patterns will also be covered.

RC316

The Aging Radiologist: How to Cope, When to Quit (Sponsored by the RSNA Professionalism Committee) (An Interactive Session)

Refresher/Informatics

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

Tue, Dec 2 8:30 AM - 10:00 AM   Location: E353B

Participants

Moderator
Donald M. Bachman MD : Nothing to Disclose
Stephen Chan MD (Presenter): Nothing to Disclose
Bruce Jonathan Barron MD (Presenter): Stockholder, Immunomedics Inc
William J. Casarella MD (Presenter): Nothing to Disclose
Robert Albert Schmidt MD (Presenter): Medical Advisory Board, Three Palm Software LLC Stockholder, Three Palm Software
LLC Spouse, Advisory Board, Three Palm Software LLC Spouse, Stockholder, Three Palm Software LLC Spouse, Medical
Advisory Board, Bayer AG Consultant, VuComp, Inc Spouse, Consultant, VuComp, Inc

LEARNING OBJECTIVES

1) Identify physiological and psychological manifestation of aging specific to performance as a radiologist. 2) Institute
non-prejudicial evaluation of function and performance of radiologists in their department as they age. 3) Understand economic,
health, emotional and professional factors that stimulate radiologists to either continue working or retire. 4) Identify strategies
for instituting meaningful and satisfying activities after retirement from active radiology practice.

RC317

MR Neurography and New Methods to Image Pain

Refresher/Informatics
MR Neurography of the Brachial Plexus and Upper Extremities
Amelie Margarete Lutz MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To understand the role of indications for MR neurography in the multidisciplinary diagnostic work-up of brachial plexus and upper extremity nerve pathologies. 2) To understand the technical requirements and challenges of MR neurography in the brachial plexus and upper extremities. 3) To get familiar with the anatomy and normal MR imaging appearance of the brachial plexus and upper extremity nerves. 4) To recognize commonly encountered pathologies and their differential diagnoses in brachial plexus and upper extremity nerves.

ABSTRACT
Continuous improvements in magnetic resonance scanner, coil, and pulse sequence technology have resulted in the ability to perform routine, high-quality imaging of the brachial plexus and upper extremity nerves. MR neurography has evolved into a very helpful diagnostic tool in the work-up of peripheral nerve and plexus pathologies. It is commonly used for the detection and preoperative staging of neural mass lesions, in evaluating inflammatory and traumatic brachial plexus changes, confirming and/or complementing electrophysiologic exams. This talk will focus on the technical requirements for imaging the brachial plexus and upper extremities, discuss the anatomy, and demonstrate relevant examples of normal and abnormal findings.

MR Neurography of the Lumbar Plexus and Lower Extremities
Avneesh Chhabra MD (Presenter): Research Grant, Siemens AG Research Consultant, Siemens AG Research Grant, Integra LifeSciences Holdings Corporation Research Grant, General Electric Company Consultant, ICON plc

LEARNING OBJECTIVES
1) Employ new techniques for LS plexus and lower extremity evaluation. 2) Understand the difference between normal and abnormal imaging appearances of LS plexus and lower extremity peripheral nerves. 3) Discuss the differential diagnosis of various LS plexus and lower limb nerve pathologies based on available clinical history and imaging findings. 4) Learn how to incorporate the MRN modality in the diagnostic algorithm of plexopathies and related peripheral neuropathies in a multi-disciplinary fashion.

ABSTRACT
Lumbosacral plexus has a complex anatomy with a number of nerve convergences and divergences resulting in formation of multiple essential peripheral nerves that provide motor and sensory function to the pelvis and lower extremities. Due to the deep location and complexity, MR neurography (MRN) plays a major role in evaluation of its normalcy and pathologic states. This talk will discuss current state of the art techniques available for LS plexus evaluation and show normal and abnormal imaging appearances of various common and uncommon pathologic states involving LS plexus and its branch nerves. The talk will specifically address new 3D techniques that suppress vessel signal effectively while preserving effective nerve visualization. Role of MRN in chronic pelvic pain, nerve injuries and its incremental value over conventional lumbar spine imaging will be discussed. Current role of functional DTI in qualitative and quantitative assessment of nerve pathology and tumors will be highlighted.

DTI of the Peripheral Nervous System
Gustav Andreisek MD (Presenter): Grant, Holcim Ltd Grant, Siemens AG Speaker, Mepha Pharma AG Speaker, Guerbet SA Travel support, Guerbet SA Consultant, Otsuka Holdings Co, Ltd Travel support, Otsuka Holdings Co, Ltd Institutional Research Grant, Bayer AG Institutional Research Grant, Guerbet AG Institutional research collaboration, Siemens AG Institutional research collaboration, Koninklijke Philips NV Speaker, General Electric Company Speaker, Koninklijke Philips NV Speaker, Siemens AG

LEARNING OBJECTIVES
1) Identify the basic microanatomy of peripheral nerves, main pathologic conditions, and physiologic principles of diffusion-weighted tensor imaging (DTI). 2) Apply diffusion-weighted tensor imaging (DTI) to imaging protocols for peripheral neuropathies, used for both, research and clinical practice. 3) Analyze diffusion-weighted tensor imaging (DTI) images both quantitatively and qualitatively. 4) Understand the current applications but also limitations of diffusion-weighted tensor imaging (DTI) of peripheral nerves.

ABSTRACT
**Diffusion tensor imaging (DTI)** is an MR imaging technique which uses the random motion (diffusion) of water molecules within biologic tissues. Due to the tissues' distinct structural properties, the diffusion is hindered in some directions but at the same typically not hindered in other directions. DTI is a well known imaging technique in the brain and central nervous system, but its application to the peripheral nervous system was limited in the past due to multiple technical reasons. However, numerous recent studies show now that the technique cannot only be applied successfully to image peripheral nerves, but they also showed that the technique is very sensitive and specific for the detection of peripheral nerve injuries and other neuropathies. DTI may also serve as a biomarker for the demyelination of axons and the extend of nerve fiber loss. The refresher course will cover the basic principles of DTI, the challenges and limitations for imaging protocols, as well as the evaluation of DTI images (both quantitatively and qualitatively). MR tractography of peripheral nerves will also be covered.

**PET and MR Methods to Image Pain**

**Sandip Biswal MD (Presenter): Co-founder, SiteOne Therapeutics Inc Consultant, General Electric Company Stockholder, Atreus Pharmaceuticals Corporation**

**LEARNING OBJECTIVES**

1) Understand the challenges of current conventional imaging approaches in diagnosing peripheral pain generators. 2) Understand the basis for identifying specific molecular and cellular biomarkers of pain and how these biomarkers can be exploited with molecular and cellular imaging techniques. 3) Demonstrate both clinical and pre-clinical PET/MR or advanced MRI approaches in identifying pain generators.

**ABSTRACT**

Chronic pain is now the prevalent disease in the world. The chronic pain sufferer is currently faced with a lack of objective tools to identify the source of their pain. The goal of this session is to describe new clinical molecular imaging and emerging molecular/cellular imaging methods to more accurately localize chronic pain generators/drivers so that we may objectively identify and more intelligently act upon the cause in a pain sufferer. Successful imaging of pain is relying heavily upon a multidisciplinary effort that include expertise from a number of scientists and clinicians in the fields of synthetic chemistry, radiochemistry, magnetic resonance physics/engineering, molecular pain neurobiology, clinical pain, radiology and others. A number of clinical and emerging pre-clinical approaches in positron emission tomography (PET) and magnetic resonance imaging (MRI) will be described. These imaging methods will demonstrate how the site of increased nociceptive activity is highlighted in the peripheral nervous system and spinal cord.

**Imaging of Tumor Syndromes (An Interactive Session)**

**RC318**

**Refresher/Informatics**

**AMA PRA Category 1 Credits ™**: 1.50
**ARRT Category A+ Credits**: 1.50
**Tue, Dec 2 8:30 AM - 10:00 AM Location: S402AB**

**Sub-Events**

**RC318A Von Hippel Lindau and Other Hereditary Renal Cancer Syndromes**

**Peter L. Choyke MD (Presenter): 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 identify the key genetic aspects of von Hippel Lindau (VHL) disease and their relevance to treatment. 2) To distinguish radiologic features of VHL from other hereditary renal cancers. 3) To explain the implications of hereditary renal cancers for sporadic renal cancers.

**ABSTRACT**

Hereditary renal cancers include clear cell carcinomas associated with von Hippel Lindau Disease (VHL), chromophobe carcinomas associated with Birt Hogg Dube, papillary carcinomas associated with hereditary papillary cancer syndrome and type II papillary carcinomas associated with Hereditary Leiomyoma-Renal Carcinoma (HLRC) syndrome. Additional rare syndromes exist. This talk will focus on the distinguishing features of each entity from a radiologic perspective but also will describe the lexicon underlying the description of the genetics of these entities. This should enable the participant to understand the 'language' of genetics when describing hereditary entities in general, including terms such as tumor suppressor gene, oncogene, hypoxia inducible factor and metabolomics. The participant should come away with a fuller understanding of these hereditary entities and their implications for more common, sporadically occurring renal cancers.

**RC318B Neurocutaneous Syndromes**

**Petra Vajtai MD (Presenter): Nothing to Disclose**
**LEARNING OBJECTIVES**

1) To identify the key distinguishing radiologic features of each of the most common phakomatoses: neurofibromatosis types I and II, tuberous sclerosis, and Sturge-Weber syndrome. 2) To provide guidance on the appropriate use of surveillance imaging in affected individuals.

**ABSTRACT**

The phakomatoses are a group of hereditary neuroectodermal diseases, each characterized by its unique cutaneous as well as radiologic manifestations. The most common phakomatoses are neurofibromatosis (types I and II,) tuberous sclerosis, and Sturge-Weber syndrome, whose respective characteristic neuroradiological finding is the neurogenic tumor, the tuber and angiomatosis. The talk should enable the participant to distinguish the addressed phakomatoses based on radiologic characteristics, to describe the presentation, diagnosis and prognosis of each, and to provide guidance on the appropriate use of surveillance imaging in affected individuals.

**RC318C**

**Multiple Endocrine Neoplasia**

Bryan Robert Foster MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Distinguish between MEN 1 (Wermer) and MEN 2a (Sipple) syndromes. 2) Describe which syndromes have significant gastrointestinal features. 3) Identify syndromes associated with pheochromocytoma.

**RC318D**

**Lynch and Other Hereditary Colonic Cancer Syndromes**

Richard Kinh Gian Do MD, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the advances in genetics for Lynch and other hereditary colonic cancer syndromes. 2) Identify the gastrointestinal and non-GI malignancies of Lynch and other polyposis syndromes. 3) Examine the role of imaging for monitoring hereditary colonic cancer syndromes.

**RC320**

**New Paradigms for the Treatment of Hodgkin's and non-Hodgkin's Lymphomas: The Crucial Role of Imaging**

*Refresher/Informatics*

**Refresher/Informatics**

**Participants**

Moderator
Stephanie A. Terezakis MD : Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the role of computed tomography and positron emission tomography-CT in the management of patients with Hodgkin and non-Hodgkin lymphoma. 2) To become familiar with the International Working Group Criteria, which integrate PET findings into lymphoma response assessment. 3) To become familiar with limitations of PET-CT in assessing lymphoma response by PET-CT. 4) To become aware of pitfalls (false positives) of PET-CT in the response assessment of patients with lymphoma.

**ABSTRACT**

Although computed tomography remains the gold standard for assessment of lymphoma response to therapy, PET-CT plays an important role for both staging and response evaluation. In this session we will review the role of imaging in lymphoma and demonstrate how it guides therapy in this patient population. The limitations of PET imaging as well as pitfalls and false positives of PET imaging will be addressed.

**Sub-Events**

**RC320A**

**Developments in Response-Adapted Clinical Management of Hodgkin and Non-Hodgkin’s Lymphoma**

David Christopher Hodgson MD, MPH (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**ABSTRACT**


Data continue to emerge that facilitate the optimal management of patients with lymphoma by tailoring the intensity of treatment based on the response to both functional and anatomic imaging. Recent studies illustrate, however, that there is no 'one size fits all' approach to utilizing FDG-PET, CT and MRI to evaluate response and adjust treatment accordingly. This session will review recent data regarding the use of functional and anatomic imaging to manage lymphoma with emphasis on 1. technical aspects of obtaining optimal images, and recognizing pitfalls in lymphoma imaging 2. understanding reporting needs of oncologists with respect to clinical decision making, 3. the use of functional imaging for radiation therapy planning, and chemotherapy modification, and 4. emerging standards regarding the use of imaging in follow-up of treated patients.

**RC320B**

**Tools and Considerations for Response Assessment in Hodgkin and Non-Hodgkin's Lymphoma**

*Steve Cho MD (Presenter): Nothing to Disclose*

**LEARNING OBJECTIVES**

- View learning objectives under main course title.

**RC321**

**Medical Physics 2.0: Information Management and Display**

*Refresher/Informatics*

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

**Tue, Dec 2 8:30 AM - 10:00 AM   Location: S403B**

**Sub-Events**

**RC321A**

**Information Management and Display Perspective**

*Ehsan Samei PhD (Presenter): Research Grant, Siemens AG Research Grant, General Electric Company Research Grant, Carestream Health, Inc*

**LEARNING OBJECTIVES**

1) To gain an appreciation for interaction between medical physics and information technology in modern medicine
2) To understand how physics can add value to patient care in the area of information and image management and technology.

**RC321B**

**Information Management and Display 1.0**

*Donald Peck PhD (Presenter): Nothing to Disclose*

**LEARNING OBJECTIVES**

1) Review the different areas of imaging informatics.
2) Understand the methodology for developing informatics standards and their current status
3) Understand the components of various informatics systems
   a. Enhanced DICOM objects
   b. Vender neutral archives for enterprise image storage
   c. Web distribution protocols
   d. Dose monitoring
   e. Reporting systems
   f. Structured reports

**ABSTRACT**

Imaging informatics is part of every radiology practice today. Imaging informatics covers everything from the ordering of a study, through the data acquisition and processing, display and archiving, reporting of findings and the billing for the services performed. The standardization of the processes used to manage the information and methodologies to integrate these standards is being developed and advanced continuously. These developments are done in an open forum and imaging organizations and professionals all have a part in the process. In this presentation the flow of information and the integration of the standards used in the processes will be reviewed. The role of radiologists and physicists in the process will be discussed. Current methods for validation of informatics systems function will also be discussed.

**RC321C**

**Information Management and Display 2.0**

*Michael James Flynn PhD (Presenter): Nothing to Disclose*

**LEARNING OBJECTIVES**

1) Review the display performance evaluation methods used for monitor QA.
2) Understand current guidelines for display systems that are used for medical imaging.
3) Learn about emerging requirements for handheld display, and color display.

RC322

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques—Site-specific IGRT Applications: Impact of Different Approaches on Uncertainties

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 8:30 AM - 10:00 AM Location: S104A

Participants

Moderator
Sonja Dieterich PhD: Scientific Advisor, MGS Research, Inc

LEARNING OBJECTIVES

1) Impact of different approaches on uncertainties for specific sites, including pelvis, HandN, thorax, and abdominal sites.

Sub-Events

Pelvis

Emilie Soisson PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Be able to describe the sources and magnitude of positional uncertainty in irradiation of the pelvis. 2) Understand the role of image guidance in localizing pelvic targets. 3) Be able to compare the imaging strategies employed in the pelvis and understand residual uncertainties associated with each system. 4) Be able to compare published results with their own clinical practice.

ABSTRACT

Detection of organ motion is required for accurate targeting in radiation therapy of the pelvis. It is well known that pelvic targets change size, shape, and location as a result of changes in bladder and rectal filling and the size and location of these organs on the planning CT cannot be easily reproduced at treatment. While organ filling can be partially controlled through dietary regulation, complete immobilization is not possible. Image guidance (IGRT) provides the opportunity to monitor inter- and intra-fraction anatomical changes to better ensure plan delivery accuracy. In turn, IGRT has allowed for margin reduction and dose escalation, especially in the case of the prostate. The potential reduction in margin is then dependent on several factors including the ability to visualize the target and the frequency of imaging. Since target anatomy is generally not rigid with respect to boney landmarks, images used for localization must provide adequate soft tissue contrast or be used in combination with implanted surrogates. Due to the variety of IGRT approaches available and the possibility of having more than one imaging system in each treatment vault, it is now possible to inter-compare different localization methods to determine the uncertainty of a particular approach. Results of these studies are surprising and suggest that even though we think we can see the prostate with our chosen image guidance strategy, back-to-back imaging with different modalities will likely reveal that the prostate not only a different size but also often in a different place. In addition, intra-fraction motion is considerable in the prostate indicating that significant margins are might be required in the absence of intra-fraction tracking.

Head and Neck

Michalis Aristophanous (Presenter): Research Grant, Varian Medical Systems, Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

Head and neck cancer is a difficult site for radiation therapy because of the complexity in target delineation, normal tissue sparing and treatment planning. Typically, head and neck patients are immobilized using thermoplastic masks, which are custom-made to fit the individual patient. Generic, or patient-specific neck supports may be used. In many institutions IGRT is considered standard of care for these patients. Thus, many of the uncertainties in head and neck treatments are minimized. However, it is important to understand the residual uncertainties. The immobilization devices are good at minimizing intrafraction movement, but the complex motions of the head and neck region mean that there can be day-to-day variations in the relative positions of different regions, such as between the neck and head. The extent of these variations has been well studied, and will be described in this presentation. There are also different approaches to the IGRT process, including the use of 2D or 3D imaging. This session will explore the uncertainties in head and neck radiation therapy, including inter-fraction variations and also variability in contouring. Mitigation strategies will be discussed. We will describe the treatment margins used by different institutions including their respective rationales.
Thorax and Abdomen
Sonja Dieterich PhD (Presenter): Scientific Advisor, MGS Research, Inc

LEARNING OBJECTIVES

1) Be able to describe the sources of uncertainties in the thorax and abdomen. 2) Learn how different respiratory motion management influence margins. 3) Gain an understanding what typical ranges of margins are for the respective methods. 4) Be able to determine appropriate margins for their respective clinical practice.

ABSTRACT

The uncertainties thorax and abdominal regions in the human body consists of overall patient setup uncertainty, respiratory motion, and organ deformation. Depending on the location of the target, a site-specific combination of these three components make up the total uncertainty. Respiratory motion compensation methods are increasingly used in clinical practice to minimize uncertainties. The most commonly used respiratory motion compensation methods are: breath-hold, abdominal compression, gating, and real-time tracking. Each method has a different impact on uncertainties. The simulation imaging also contributes to variations in uncertainties. CT artifacts which may change the contouring margins used depend on the data acquisition technology used during simulation. Free breathing, deep inspiration or expiration breath-hold, gated 4D-CT (both phase-gated and amplitude gated), scanner speed, pitch, and number of slices per revolution all influence the uncertainties. In addition to uncertainties in the position of the target, the relative position of organs at risk (OAR) to the target area may also change intra- or inter-fractionally. The concept of using OAR margins in the planning phase to anticipate potential relative shifts of OAR to target position will be discussed. Assessing OAR dose during daily image-guided patient setup can help identify setup variations exceeding OAR safe margins. Strategies to address setup variations exceeding uncertainty limits based on clinical experience will be discussed.

Minicourse: Recording and Reporting Radiation Dose: Interventional/Angiography/Fluoroscopy

Refresher/Informatics

IRA PQ PH
AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 8:30 AM - 10:00 AM Location: N229

Sub-Events

RC323A Issues in Interventional Fluoroscopy Procedures
Stephen Balter PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Be able to describe effects on patient's skin, hair, eyes, and other tissues resulting from fluoroscopically-guided interventional procedures. 2) Be able to adequately communicate FGI radiation risk as part of the informed consent process. 3) Understand the use of real-time displays of radiation quantities and their relation to radiation risks.

ABSTRACT

Some fluoroscopically-guided interventional procedures (FGI) require the use of a substantial amount of radiation for their completion. Radiation can be regarded as a toxic agent in the same sense that contrast-media and drugs can be toxic if inappropriately used. The interventional radiologist should have reasonable knowledge of the toxic effects of radiation on patients at dose levels that may occur during IR procedures. These include short-term tissue reactions on the skin, hair loss, and radiogenic cataracts. Longer term effects such as cancer induction are of importance for some patients. Because radiation is potentially toxic, its risks should be appropriately discussed during the informed consent process. The display of reference air kerma and kerma area product provide risk information to the radiologist while performing a procedure. This is intended to provide ongoing inputs into a continuous evaluation of benefit-risk.

RC323B Measurements and Dose Calculations
Beth A. Schueler PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review methods of measuring patient radiation dose during fluoroscopically-guided interventional procedures. 2) Compare the advantages and limitations of dose measurement methods. 3) Understand parameters that are used to describe patient entrance dose. 4) Learn about new methods for skin dose calculation and recording.

ABSTRACT
The measurement of patient dose during fluoroscopically-guided interventional procedures is an important tool for assessment of individual patient radiation risk. Moreover, the display of patient dose is valuable as feedback to the operator to aid in optimization of radiation exposure. Many different methods of measuring fluoroscopy dose have been developed, including direct methods (dosimeters and film) and indirect methods (fluoroscopy time, dose-area-product meters and reference point air kerma estimation). This presentation will review the advantages and limitations of each of these methods, along with common dose metrics that fluoroscopy operators, medical physicists and technologists should be familiar with. In addition, we will discuss skin dose mapping methods that are currently being developed.

Active Handout

### RC323

**Establishing an Interventional Radiology Patient Radiation Safety Program**

A. Kyle Jones PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) List the radiation dose descriptors that should be recorded at the conclusion of a fluoroscopy-guided procedure.
2) Describe the actions that may be taken during the three phases of a fluoroscopy-guided procedure to enhance patient safety.
3) Discuss how to recognize cases that are outside the normal control limits of an interventional radiology practice.

**ABSTRACT**

An interventional radiology patient safety program is essential to better educate patients who are scheduled to undergo fluoroscopically guided interventional radiology procedures; monitor radiation doses delivered during procedures and reduce the risk of tissue effects; ensure appropriate medical management of patients experiencing significant peak skin doses; and for practice quality improvement through analysis of procedural data and exceptional cases. The program combines preprocedure evaluation and counseling, intraprocedure monitoring, and postprocedure documentation and counseling consistent with guidelines from the National Cancer Institute and the Society of Interventional Radiology. Implementation of a patient safety program is straightforward, requires little infrastructure and few resources, and can be applied in most interventional radiology practices.

### RC324

**Extranodal Lymphoma from Head to Toe (In Conjunction with the American Institute for Radiologic Pathology)**

*Refresher/Informatics*

**Participants**

Moderator: Mark Douglas Murphey MD : Nothing to Disclose
Jeffrey R. Galvin MD (Presenter): Nothing to Disclose
Aletta Ann Frazier MD (Presenter): Nothing to Disclose
Ellen M. Chung MD (Presenter): Nothing to Disclose
Leonard M. Glassman MD (Presenter): Nothing to Disclose
Kelly Karl Koeller MD (Presenter): Nothing to Disclose
Maria Ann Manning MD (Presenter): Nothing to Disclose
Darcy Jennifer Wolfman MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the typical clinical and pathologic features of extranodal lymphoma.
2) Define the characteristic imaging patterns of extranodal lymphoma.
3) Identify the pathologic and imaging manifestations of lymphoma in immunocompromised patients and their variation from lymphoma occurring in immunocompetent individuals.
4) Understand the pathologic basis for the imaging patterns of extranodal lymphoma.

### RC325

**Quantitative Imaging: Volumetric CT as a Biomarker for Disease**

*Refresher/Informatics*

**Participants**

Moderator: Mark Douglas Murphey MD : Nothing to Disclose
Jeffrey R. Galvin MD (Presenter): Nothing to Disclose
Aletta Ann Frazier MD (Presenter): Nothing to Disclose
Ellen M. Chung MD (Presenter): Nothing to Disclose
Leonard M. Glassman MD (Presenter): Nothing to Disclose
Kelly Karl Koeller MD (Presenter): Nothing to Disclose
Maria Ann Manning MD (Presenter): Nothing to Disclose
Darcy Jennifer Wolfman MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the typical clinical and pathologic features of extranodal lymphoma.
2) Define the characteristic imaging patterns of extranodal lymphoma.
3) Identify the pathologic and imaging manifestations of lymphoma in immunocompromised patients and their variation from lymphoma occurring in immunocompetent individuals.
4) Understand the pathologic basis for the imaging patterns of extranodal lymphoma.
Why is Quantitative Imaging (Tumor Volumes) Needed in Oncologic Imaging

Lawrence H. Schwartz MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the role and value of quantitative volumes in oncology. 2) To understand the challenges associated with quantitative volume calculations in oncology.

Understanding Measurement Variation: Lessons Learned from Phantom Studies

Nicholas Petrick PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review how changes in CT acquisition parameters and nodule characteristics affect measurement error. 2) To review how phantom studies can be used to systematically probe, identify and potentially minimize measurement error and improve our ability to perform quantitative CT imaging. 3) To understand which CT and analysis parameters should be held constant across multiple CT scans, if at all possible, to optimize the evaluation of a patient's response to therapy.

ABSTRACT

In this refresher course, we will update the audience on the methods and results obtained from various phantom studies developed to assess both absolute lesion size measurements and change over time measurements involving both automated and semi-automated lesion sizing tools.

Variability in CT Measurement of Tumor Volumes and Its Impact on Response Assessment

Binsheng Zhao DSc (Presenter): License agreement, Varian Medical Systems, Inc License agreement, Keosys License agreement, Hinacom Software and Technology, Ltd License agreement, AG Mednet, Inc

LEARNING OBJECTIVES

1) Demonstrate the feasibility of computer-aided (tumor) volume measurement and explain its potential to improve conventional response assessment in oncology. 2) Familiarize the audience with sources of variation in measuring tumor volume and tumor volume change. 3) Discuss the need for standardizing both imaging and measurement techniques in the interpretation of tumor measurement and thus in response assessment.

ABSTRACT

Volumetric CT (VoICT) shows potential as a better method to assess tumor response, especially early response, to therapy than the conventional diameter methods. This refresher course will first show how the volumes of solid tumors can be accurately and practically obtained with the help of computer software, then discuss the factors that can affect measurement reproducibility of in vivo tumors during image acquisition and tumor measurement. By becoming acquainted with a well-designed series of (clinical) variability studies, the audience will learn the magnitudes of variability that can occur in the measurement of tumor volumes, as well as in tumor diameter(s).
**ABSTRACT**

Allegations of medical negligence are not infrequent in radiologic practice. This course will cover the demographics of radiology malpractice from the perspective of a medical director at a major malpractice insurance carrier, with an emphasis on the frequency and economic impact of radiology litigation, and a description of how cases are evaluated by a major malpractice carrier. Additional topics covered by the remaining two lecturers will be the importance of communication between radiologists and other health care providers, emphasizing examples of how communication breakdowns between healthcare providers can occasionally result in allegations of negligence. Finally, the topics of radiologic interpretive errors and their potential role in radiology litigation will be explored, focusing on body imaging.

**RC329**

*Interactive Game: Clinical Problems in Body MRI—Case-based Instruction*

*Refresher/Informatics*

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 8:30 AM - 10:00 AM  Location: E350

**LEARNING OBJECTIVES**

This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

**Sub-Events**

**RC329A**

*Liver Lesion Differential Diagnosis*

Christopher Geordie Roth MD (Presenter): Author, Reed Elsevier

**LEARNING OBJECTIVES**

1) To appreciate and understand the typical imaging appearances of common liver lesions. 2) To understand the algorithmic approach to liver lesion differential diagnosis. 3) To understand how information from the various pulse sequences and contrast agents contribute to liver lesion assessment.

**ABSTRACT**

Given the ubiquitousness of liver lesions on imaging studies, it is incumbent upon radiologists to accurately characterize these lesions and differentiate benign from malignant. While the vast majority of liver lesions are benign incurring no further treatment or management and their features need to be recognized, the management of indeterminate and malignant lesions ranges from percutaneous biopsy to surgery to chemotherapy and a confident diagnosis or differential diagnosis should be pursued before these invasive measures are undertaken. While many lesions are adequately characterized on other imaging modalities, many require further analysis with MRI and some may initially present at MR imaging. Given the wide array of pulse sequences and protocols and proliferation of MR contrast agents, assimilating all of the necessary imaging information to generate an accurate diagnosis or differential diagnosis can be challenging. MRI is considered the most comprehensive and accurate modality for noninvasive assessment of liver lesions and in the majority of cases, a confident lesion diagnosis is possible based on the composite information from multiple pulse sequences. While many lesions exhibit classic features rendering diagnosis straightforward, lesions occasionally demonstrate unusual or atypical features that may complicate accurate diagnosis and familiarity with these infrequent appearances is important for accurate characterization and discrimination between benign and malignant etiology. The utility of the various MRI pulse sequences and contrast agents will be discussed and a diagnostic algorithm will be presented to help classify and accurately diagnose liver lesions.

**RC329B**

*Pancreatic Cysts—Achieving Consistency and Common Sense*

Masoom A. Haider MD (Presenter): Consultant, Bayer AG

**LEARNING OBJECTIVES**

1) To recognize the classic MRI findings for cystic pathologies of the pancreas. 2) To have a pragmatic approach to management recommendations of cystic lesions of the pancreas based on current guidelines.

**ABSTRACT**

With the widespread use of cross sectional imaging cystic pancreatic lesions are being detected with increasing frequency. The dominance of pseudocyst as the commonest type of pancreatic cyst may no longer hold. Radiologists must be familiar with the features of cystic neoplasms. MRI offers excellent tissue contrast for characterization of pancreatic cysts as well as for assessment of relationship to the pancreatic duct which can be helpful for differential diagnosis. A number of MRI features can be used to help guide management and offer likely differential diagnosis and will be presented. At the same time MRI has resulted in increased detection of
tiny incidental simple pancreatic cysts for which limited or no followup may be necessary. It is important to recognize that in some cases MRI and other non-invasive imaging methods cannot provide reliable diagnosis as there is substantial overlap in imaging findings between some benign and pre-malignant or malignant cystic neoplasm. These scenarios will be reviewed in the context of current published guidelines to enable a pragmatic approach to pancreatic cyst evaluation.

URL's


RC329C

Cholangiocarcinoma—Addressing a Difficult Challenge
Kartik Sudhir Jhaveri MD (Presenter): Research Grant, Bayer AG Speaker, Bayer AG

LEARNING OBJECTIVES

1) To emphasize an optimal MR imaging protocol. 2) To highlight role of MRI in the diagnosis and classification. 3) To demonstrate the role of MRI in staging. 4) To understand limitations of MRI and review "mimics" of cholangiocarcinoma.

ABSTRACT

Although Cholangiocarcinoma is a rare tumour (<2% of all cancer), it is the second most common primary Hepatobiliary malignant tumour after hepatocellular carcinoma (HCC). This tumour actually encompasses a diverse group of tumours varying greatly in location, growth pattern and histology resulting in a gamut of imaging manifestations. It is important to be familiar with those diverse manifestations to provide accurate detection and characterization. Since only surgery can provide curative therapy, accurate resectability assessment is critical. Defining an optimal MRI protocol which includes precontrast MR imaging along with high resolution MRCP sequences and Dynamic contrast acquisitions/MR angiography is necessary to ensure accurate results. MRI offers unique advantages via its ability to provide information noninvasively in a single test regards tumour size, extent, vascular involvement, nodes and extrahepatic spread. MRCP can superbly display bile ducts upstream to an obstruction. MRI is not without limitations. In some cases other disease process may mimic cholangiocarcinoma and these will be discussed. At times MRI may not be able to confidently detect or stage the tumor and correlative imaging with Ultrasonography, CT and PET needs to be considered.


RC332

How to Avoid Failure: Qualities of a Successful Leader

LEARNING OBJECTIVES

1) Develop an understanding of the essential traits and skills required for a leader to be successful, ie traits and states. 2) Develop an understanding of the common errors made by leaders in academic and private practices enabling the attendee to obtain the 'learnings' without the 'lumps. 3) Acquire the skills of succession planning needed to ensure that the success of your organization is sustainable over time and leadership transitions. (This course is part of the Leadership Track)

Sub-Events

RC332A

How Leaders Succeed and Fail
James H. Thrall MD (Presenter): Board Member, Mobile Aspects, Inc Board Member, WorldCare International, Inc

LEARNING OBJECTIVES

View learning objectives under main course title. (This course is part of the Leadership Track)

RC332B

Keys to Avoid Failure: Key Qualities of a Successful Leader
Norman Joseph Beauchamp MD (Presenter): Institutional research agreement, Koninklijke Philips NV Institutional research agreement, General Electric Company Research Grant, Koninklijke Philips NV

LEARNING OBJECTIVES

View learning objectives under main course title. (This course is part of the Leadership Track)
Leadership: An Evolutionary Framework, Historical Examples of Leaders, and Personal Lessons Learned

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

LEARNING OBJECTIVES

1) Recognize historical examples of leaders, in addition to how you can recognize and emulate their favorable characteristics that draw you to their leadership attributes. 2) Understand an overview of leadership references, where and how to access the same, how the related body of knowledge has evolved, and current perspectives concerning leaders and leadership. (This course is part of the Leadership Track)

CTA from Head to Toe (How-to Workshop)

RC350

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 8:30 AM - 10:00 AM Location: E260

Participants

Moderator
Alison Wilcox MD : Speaker, Toshiba Corporation

Sub-Events

RC350A Cardiac CT- Pre, Peri and Post Procedural Management

Bonnie Garon MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review preprocedural patient preparation including appropriate patient selection, beta blockade, contraindications and alternatives beta blockers. 2) Discuss how to manage nonstandard patients (atrial fibrillation, pacemaker, young adults). 3) Periprocedural issues including vasodilation, continued heart rate control, and breathholding requirements. 4) Image acquisition including radiation dose reduction techniques, technique choice, and post CABG patient. 5) Postprocedural complications include contrast reactions and their management.

ABSTRACT

Cardiac CTA involve slightly more preparation than the standard CT acquisition. Heart rate control is the most important aspect that needs to be addressed prior to the patient arriving in the radiology department. Periprocedural issues mostly involved how to optimize technique while having the lowest radiation dose especially in the new age of dose reduction. Almost as important as heart rate management is how to treat postprocedural complications especially contrast reactions. This presentation will discuss these aspects and include treatment options as well as their alternatives.

RC350B TEVAR/EVAR- Pre, Post and Periprocedural Evaluation

Alison Wilcox MD (Presenter): Speaker, Toshiba Corporation

LEARNING OBJECTIVES

1) What are some clinical indications for acute aortic imaging. 2) What are some CT parameters that can aid in various diagnosis? 3) What are some of common complications seen in TEVAR and EVAR? 4) What are the important measurements and vessel variants that help guide surgical approach. 5) New suggestions for type B management. 6) What are some imaging problems and pitfall and some methods to assist. 7) Briefly discuss TAVR acquisition.

ABSTRACT

The acute aorta is part of a syndrome of diseases affecting the aorta with significant overlap of findings and clinical presentations. Clinically the diagnosis is difficult as there is overlap between patients with suspected coronary disease, pulmonary embolism and acute aortic syndrome. In the past several years, minimally invasive surgery with Thoracic Endovascular Aortic Repair (TEVAR) or Endovascular Aortic Repair (EVAR) have become increasingly popular. The images choices include gated vs non gated studies, non-contrast imaging, and delayed imaging. The literature is mixed on how and when to use these modalities. The complications of these procedures is often complex and subtle as well. Knowledge of these vascular complications is imperative for patient management. In addition, these patients often have significant atherosclerotic disease elsewhere that might be limiting factors for stent placement, including renal insufficiency. Newer scanners and imaging
Peripheral CTA—A How-to
Ilya Lekht MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Enhance knowledge of normal and abnormal coronary and cardiac anatomy, with an emphasis on differentiating benign from significant variants. 2) Demonstrate the spectrum of nonatherosclerotic congenital and acquired diseases that may affect the coronary arteries. 3) Demonstrate the spectrum of non-atherosclerotic congenital and acquired diseases that may affect the heart.

ABSTRACT

A variety of non-atherosclerotic conditions are detectable on cardiac CT scans, including diseases of the heart, and disease processes which may affect the coronary arteries, or other vascular structures. Cardiac CT has a number of unique advantages in detecting non-atherosclerotic conditions, including congenital and acquired diseases. The focus of this presentation will be non-atherosclerotic conditions of the coronary arteries and of the heart. Variants of normal and abnormal anatomy of the coronary arteries will be discussed, including tips for identifying when coronary anatomic variants are significant. Acquired, non-atherosclerotic diseases of the coronary arteries will also be discussed. This presentation will also discuss the spectrum of non-atherosclerotic diseases of the heart which may be detected at cardiac CT, including congenital and acquired valvular and cardiac diseases. At the end of this exhibit, the viewer will have a better appreciation for abnormal coronary and cardiac anatomy and the broad spectrum of non-atherosclerotic cardiovascular diseases which may be seen at cardiac CT.

Pitfalls in Liver Imaging (How-to Workshop)

Refresher/Informatics

Khaled M. Elsayes MD (Presenter): Nothing to Disclose
Richard L. Baron MD (Presenter): Speakers Bureau, Bracco Group
Janio Szklaruk MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe most commonly encountered imaging pitfalls of the liver. 2) Describe relevant technical background, pathophysiology and hemodynamics of these pitfalls. 3) List tips to avoid erroneous diagnosis and clues to reach correct diagnosis.

ABSTRACT

There is a wide range of common pitfalls in liver imaging, which can lead to frequent incorrect diagnoses mainly because many radiologists are not completely familiar with anatomical, morphological, physiological, hemodynamic and biological principles as well as deficiency of modern clinical and radiological knowledge. This leads to common misinterpretations which would further results in wrong management with potentially negative outcome. In this course, we discuss a spectrum of these pitfalls according to the following organization: In this course, we discuss a spectrum of these pitfalls which can be classified to: 1. Diagnostic pitfalls a. Mistaking benign lesions for malignant lesions b. Mistaking malignant lesions for benign lesions 2. Technical pitfalls a. CT, US, MR specific issues that create difficulties in diagnosis b. Technique pitfalls 3. Organizing pitfalls by liver status a. Pitfalls in imaging chronic liver disease (cirrhosis) b. Pitfalls in noncirrhotic liver 4. Atypical presentations of common benign lesions 5. Atypical presentations of common malignant lesions 6. Organization according to imaging findings

URL’s

https://www.radiology.uchicago.edu/page/faculty-lectures

Doppler US: Abdominal and Visceral Applications (Hands-on Workshop)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 8:30 AM - 10:00 AM Location: E264
LEARNING OBJECTIVES

1) Understand basic concepts associated with abdominal and visceral Doppler. 2) Describe ultrasound techniques, protocols, and diagnostic criteria for evaluation of abdominal and visceral arteries. 3) Gain experience in Doppler techniques through personalized hands-on scanning of models with a variety of ultrasound machines. 4) Describe common pitfalls in Doppler examinations.

ABSTRACT

This hands-on course will focus on the details that constitute good Doppler technique in the evaluation of vascular flow within the abdomen and pelvis. Technical considerations for optimization of Doppler images will be discussed and the concepts will be applied to abnormalities commonly encountered in patients. Initial two brief lectures will begin by discussing important aspects of abdominal and visceral Doppler. The majority of the session will give participants an opportunity to scan live models to improve technical skills in color and spectral Doppler. Faculty will be available at multiple stations using a variety of ultrasound machines. Participants will be encouraged to inquire about specific arterial territories of interest in the abdomen and pelvis during the hands-on component of the course.
Blood Flow in the Thoracic Aorta Elucidated with 3D Models
Michael Markl PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
Flow sensitive MRI offers the ability to assess anatomy as well as flow characteristics in healthy and pathological blood vessels and is therefore an attractive tool for the diagnosis of vascular diseases. However, in-vivo studies do not allow the prediction of hemodynamic changes due to vascular modifications. Realistic vascular in-vitro 3D phantoms in combination with MRI flow measurements allow to model different vascular deformations and evaluate their effect on blood flow dynamics. This presentation will provide a review of the methods for the in-vitro simulation of aortic 3D blood flow with realistic boundary conditions and review previously reported application for the simulation of common aortic pathologies and their impact on aortic hemodynamics.

3D Printing in Interventional Radiology and Vascular Surgeries
Matthew D Tam FRCR (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Describe potential workstream flows from CTA to a 3D printed model of the aorta. 2) Discuss the potential role of solid and hollow models of the vasculature to aid procedure planning, procedure execution and patient outcomes. 3) Gain an insight into future developments of the 3D printing industry.

ABSTRACT
3D printing has a major role to play in healthcare - procedure planning and execution, implant and device design, as well as facilitating better patient communication strategies and patient outcomes. Anatomically accurate patient-specific models of the vasculature can be constructed using 3D printing technologies. CT angiograms and DICOMs can be processed and the data converted into computer-aided design files using a range of different techniques and software. CAD files can then be 3d printed. In the setting of endovascular aneurysm repair, solid models of the lumen can be created and may be used to better understand complex anatomy. Hollow models can be created which can facilitate procedure execution through patient-specific rehearsal. 3D printing technologies will have further impact upon vascular and interventional radiology as both software, hardware and material science improves.

3D Printing in Otolaryngology
Glenn E. Green MD (Presenter): Nothing to Disclose, Maryam Ghadimi Mahani MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

3D Printing of Viable Tissues
Roger R. Markwald PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the development of the use of 3D applications in support of surgical reconstruction. 2) Describe the use of 3D Medical Applications in the support of Wounded Warrior Care.

ABSTRACT
Digital design and manufacturing technologies have been leveraged by the military in support of Wounded Warrior care since before the year 2000. A dedicated service for medical modeling was developed at the WRNMMC to provide 3D planning and manufacturing in the support of the DOD and wounded warrior care, expanding services to surgical simulations, development of surgical guides and custom implants, as well as support of research, occupational health and prosthetics world-wide. The purpose of this presentation is to present a review of the development of the use of digital design, digital manufacturing, and the establishment of 3D Medical Applications Center in support of Wounded Warrior Care.

URL's
http://www.wrnmmc.capmed.mil/ResearchEducation/3DMAC/SitePages/home.aspx

Future Applications in 3D Printing
Frank John Rybicki MD, PhD (Presenter): Research Grant, Toshiba Corporation
LEARNING OBJECTIVES

1) To review the current innovative literature in 3D printing related to radiology. 2) To hypothesize and discuss future applications in 3D printing for radiology.

ABSTRACT

One of the main applications of 3D visualization is to enhance diagnoses for which the anatomy in question is complex. Additionally, the planning for a specific intervention often requires a volumetric assessment. 3D printing in radiology is rapidly growing as a means to realize real 3D objects in 2D surfaces. The promise of this technology in the near future has spawned several new hypotheses that may define future applications. The purpose of this lecture is to review the literature and discuss novel ways that printed models can enhance radiology diagnoses and investigations.

URL's

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

RC354

Health IT Incentive Programs: Experience from Radiology Practices in Hospitals and Health Systems

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 8:30 AM - 10:00 AM Location: S102C

Participants

Moderator
Ramin Khorasani MD : Consultant, Medicalis Corp
Ramin Khorasani MD (Presenter): Consultant, Medicalis Corp
Curtis P. Langlotz MD, PhD (Presenter): Shareholder, Montage Healthcare Solutions, Inc Advisory Board, Reed Elsevier
Advisory Board, Activate Networks, Inc Spouse, Consultant, Johnson & Johnson
Keith David Hentel MD, MS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the meaningful use program. 2) Learn how hospitals and health systems have achieved meaningful use for their radiologists. 3) Decide how your practice should respond to the program.

RCA31

Slicer: Quantitative Medical Imaging for Clinical Research and Practice (Hands-on)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 8:30 AM - 10:00 AM Location: S401AB

Participants

Sonia Marie-Aurore Pujol PhD (Presenter): Nothing to Disclose
Katarzyna J. Macura MD, PhD (Presenter): Nothing to Disclose
Ron Kikinis MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Enhance interpretation of DICOM images through the use of 3D visualization. 2) Gain hands-on experience with quantitative imaging tools developed in clinical research. 3) Present current directions of quantitative imaging biomarkers in clinical trials.

ABSTRACT

Quantitative imaging has the potential to bring valuable information for the assessment of treatment response. Technological breakthroughs in medical imaging hardware and the emergence of increasingly sophisticated image processing algorithms permit the estimation of quantitative parameters with increasing sensitivity and specificity. For the past 10 years, the National Alliance for Medical Image Computing (NA-MIC), one of the seven National Centers for Biomedical Computing funded by the National Institutes of Health, has converted some of the major scientific advances made by the biomedical imaging community into open-source software tools. As part of the NA-MIC toolkit, the 3D Slicer open-source software has been developed as a technology delivery platform for clinical researchers. The course provides an introduction to quantitative medical imaging data analysis and includes a series of hands-on sessions using 3D Slicer. Cases from multiple imaging modalities and from multiple organ systems will be highlighted to illustrate the depth and breadth of this field. The hands-on sessions will give participants a practical experience of the latest quantitative image analysis tools developed in clinical research. Course url: http://www.na-mic.org/Wiki/index.php/RSNA_2014
RCB31

Creating Radiology eBooks for the iPad (Hands-on)

Refresher/Informatics

URL's
http://www.na-mic.org/Wiki/index.php/RSNA_Quantitative_Imaging_Course

Creating Radiology eBooks for the iPad (Hands-on)

Refresher/Informatics

IN ED IN ED IN ED

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 8:30 AM - 10:00 AM   Location: S401CD

Participants
Henry J. Baskin MD (Presenter): Nothing to Disclose
Justin Cramer MD (Presenter): Nothing to Disclose
Justin LaPlante MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Become familiar with Apple's free ebook authoring tool, iBooks Author. 2) Create a sample radiology ebook during the course. 3) Learn how to freely share your ebook with others.

ABSTRACT
The iPad is rapidly becoming the de facto learning tool used by radiology residents and fellows. iBooks Author, a free authoring tool from Apple, enables the creation of ebooks with a near-limitless number of high-resolution images, movies, and other interactive elements. Unfortunately, most radiologists lack the expertise to leverage the advantages of this application. This hands-on workshop will cover the basics of iBooks Author. During the course, attendees will create their own interactive radiology ebook and learn how to freely share it with anyone who has an iPad. iBooks author is only available for Mac OS and bringing your own Mac is required for the hands-on portion of the course. Attendees are encouraged to download iBooks Author prior to attending; the link is provided below. Attendees are also encouraged to come with an idea for their own iBook, ideally with a text file and folder of images they would like to turn into an ebook during the course. Sample text and images will be provided for those who do not bring their own material.

URL's

RCC31

RadLex®: Overview of a New Lexicon for Radiology

Refresher/Informatics

RCC31A

Overview of RadLex®

Daniel L. Rubin MD, MS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Review the rationale for developing a new lexicon for medical imaging. 2) See how an imaging lexicon can be used for education, research, and clinical reporting. 3) Understand the key technical decision that were necessary to create a complete and organized vocabulary for medical imaging. 4) Learn about the formats in which RadLex is distributed and the tools that are available for maintaining and using terminology systems. 5) Discover how you can take advantage of RadLex in the development of radiology applications.

ABSTRACT
The purpose of the RadLex lexicon is to provide a uniform framework for indexing and retrieval of a variety of radiology information sources, including teaching files, research data, and radiology reports. The RadLex lexicon is unifying and supplementing radiology terms from other medical lexicons, such as the ACR Index from the American College of Radiology, the Unified Medical Language System (UMLS) from the National Library of Medicine, SNOMED-CT from the College of American Pathology, and the DICOM Content Mapping Resource. This session will explain the motivations for the creation of the RadLex imaging lexicon and describe new applications being created that leverage its rich knowledge resources, such as structured reporting, radiology information retrieval, image annotation, decision support, and computerized order entry. RadLex technical experts will describe the formats in which RadLex is distributed, and will demonstrate some of the tools available to incorporate RadLex into the development of useful software applications. An update on the recently developed RadLex “playbook” will be provided, with an overview of RadLex methods to describe radiology orderables and procedure steps.
**LEARNING OBJECTIVES**

1) Learn how the RadLex lexicon enables applications in radiology research, education, and clinical practice. 2) Describe how RadLex enables information retrieval. 3) Define the role of RadLex in RSNA’s structured reporting initiative. 4) Discover new applications of RadLex in radiology education and decision support.

**ACR Usage of RadLex® Playbook for CT Dose Registry**

Richard L. Morin PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify the challenge related to procedure code matching across institutions. 2) Describe the RadLex Playbook. 3) Explain how the RadLex Playbook can be used to harmonize data across institutions.

**Breast Series: Emerging Technologies in Breast Imaging**

**Series Courses**

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<th>DM</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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**Participants**

Moderator
- Liane Elizabeth Philpotts MD: Nothing to Disclose
- Margarita Louise Zuley MD: Research Grant, Hologic, Inc

**Sub-Events**

**VSBR31-01**

**Contrast Enhanced Digital Mammography**

D. David Dershaw MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the method of generating a contrast enhanced mammographic imaging. 2) To learn how iodine contrast enhancement differs from gadolinium enhancement. 3) To understand what the current experience in contrast mammography suggests how it might be clinically useful.

**ABSTRACT**

The presentation will review the principles behind generating a contrast enhanced digital mammographic image after the injection of iodine contrast. Risks of the procedure will be presented. Enhancement kinetics will be discussed and compared with data on gadolinium. Experience of several investigators with contrast enhanced mammography will be reviewed, and the possible clinical usefulness of contrast mammography will be discussed.

**VSBR31-02**

**The Potential Impact of Applying Magnetic Resonance Imaging ACR BI-RADS Lexicon Morphology Descriptors to Characterize Breast Lesions on Contrast Enhanced Spectral Mammography**

Rasha Mohamed Kamal MD (Presenter): Nothing to Disclose, Maha Hussein Helal MD: Nothing to Disclose, Dorria Saleh Salem MD: Nothing to Disclose, Rasha Wessam MD, PhD: Nothing to Disclose, Sahar Mansour MD: Nothing to Disclose, Marwa Anas Haggag MSc: Nothing to Disclose, Radwa Essam MBBS: Nothing to Disclose, Lamia Adel MD: Nothing to Disclose, Yassmine Mounir MD: Nothing to Disclose, Iman Godda MD: Nothing to Disclose, Nelly Alieldin MD: Nothing to Disclose

**PURPOSE**

The purpose of the study is to assess the potential impact of using the standardized MRI ACR BI-RADS lexicon lesion morphology descriptors in the characterization of breast lesions on Contrast Enhanced Spectral Mammography (CESM).

**METHOD AND MATERIALS**

Institutional review board approval and patient informed consent were obtained from 271 patients with 350 breast lesions who underwent CESM. According to the MRI morphology descriptors, lesions were classified into enhancing and non-enhancing. Enhancing lesions were classified into: focus, mass and non-mass. For characterization of mass lesions, the shape, margins and internal enhancement characteristics were assessed. For non mass lesions, the distribution and internal enhancement pattern were assessed. The validity of each
criterion was tested in correlation with data provided from revision of pathology specimens. The impact of applying the MRI morphology descriptors on the diagnostic performance of CESM was assessed.

RESULTS

The study included 148/350 (42.3%) benign and 202/350 (57.7%) malignant lesions out of which 261 lesions showed contrast uptake. The number of enhancing lesions were significantly higher (p value < 0.05) in malignant lesions (193/202, 95.5%) than in benign ones (68/148, 45.9%). Enhancing lesions were classified into focus (12/261 cases, 4.6%), mass (168/261, 64.4% cases) and non mass (81/261 cases, 31%). Irregular mass shape (p value: 0.00), un-circumscribed margins (p value: 0.00) and heterogeneous enhancement (p value: 0.027) was significantly indicative of a malignant pathology. Ring pattern of contrast uptake was identified in 24 lesions: 13/24, (54.2%) benign and 11/24 (45.8%) malignant. Segmental and regional non mass enhancement with a heterogeneous or clumped pattern was significantly higher with malignant pathologies (p value: 0.003). Applying the MRI morphology descriptors to CESM yielded a sensitivity, specificity and accuracy of 92.2%, 81.9% and 88% respectively.

CONCLUSION

The standardized ACR BI-RADS morphology descriptors; with the exception of the ring pattern of contrast uptake, can be applied in the interpretation of CESM and thus provides accurate characterization of breast lesions.

CLINICAL RELEVANCE/APPLICATION

The current study can be used as a pilot study for constructing a CESM BI-RADS lexicon that is essential for precise lesion characterization and provides pertinent guidance for appropriate management procedures.
of body weight and imaged between 2 and 6 minutes after injection. Contrast-enhanced images were taken in the suspicious breast (pre-contrast MLO view, post-contrast CC and MLO view) and contralateral breast (post-contrast MLO view). The BI-RADS classifications on CEBT were finally determined based on findings on combinations of 2D mammogram, 3D tomosynthesis and post-contrast subtraction 2D and 3D images. Women were also evaluated at 1.5T (GE) or 3T MRI (Siemens) with dedicated breast coil. Different radiologists interpreted CEBT and DCE-MRI.

RESULTS

Total 259 histological findings were available in 212 women (mean age 51.3 years, range 31-70 years). About 79% women did not have clinical symptoms. 31 women had at least two breast lesions in unilateral breasts. 8 women had bilateral breast lesions. The most common findings of lesions was microcalcification (60%). The pathology revealed 167 benign lesions and 92 breast malignancies (52 carcinoma in situ, and 40 invasive breast cancers). The sensitivity/ specificity of CEBT and DCE-MRI for diagnosing breast cancers were 93%/53% and 86%/74%, respectively.

CONCLUSION

CEBT and DCE-MRI showed similar diagnostic performance for abnormal lesions on mammogram.

CLINICAL RELEVANCE/APPLICATION

CEBT is an flexible imaging tool for women who cannot undergo breast MRI for various reasons.

VSBR31-05

The Impact of Merging New Modalities of Digital Mammography on the Proper Staging of Breast Cancer

Maha Hussein Helal MD (Presenter): Nothing to Disclose, Mai Zaglol MBCh: Nothing to Disclose, Lamia Adel MD: Nothing to Disclose, Omnia Mokhtar MD: Nothing to Disclose, Sahar Mansour MD: Nothing to Disclose, Nelly AlieIdin MD: Nothing to Disclose, Iman Godda MD: Nothing to Disclose, Rasha Mohamed Kamal MD: Nothing to Disclose, Noha Abdel Shafey MD: Nothing to Disclose, nagat mansour khalifa: Nothing to Disclose

PURPOSE

Contrast-enhanced mammography and tomosynthesis are promising applications of digital mammography required to increase conspicuity of the different breast lesions. We aimed to compare the performance of these applications in staging of breast cancer to detect the proper modality required for accurate pre-operative evaluation.

METHOD AND MATERIALS

Ethics committee approval was obtained in this retrospective analysis where examinations of 115 masses in 103 cases were done. Evaluation methods included regular digital mammography, 3-D tomosynthesis and contrast enhanced spectral mammography. For acquisition the system attains a 'Combo-mode' imaging technique (2D+3D imaging) that acquires a traditional digital mammogram and a tomosynthesis scan in the same compression. For contrast-enhanced images: low (22-33 kVp) and high (44-49 kVp) energy exposures were taken in the same projections after IV injection of contrast agent. Evaluated masses were biopsied and proved malignancy (70 masses) were further evaluated regarding lesions’ extension, size, multiplicity and related calcifications.

RESULTS

Tomosynthesis provided near estimation of cancer extension to pathology data (n=58, 83%) followed by contrast-enhanced (n=32, 46%) and regular mammography (n=51, 73%). Contrast-enhanced mammography presented the least assessment for calcifications, yet the most accurate size estimation with a median value of 0.4 compared to 0.5 and 1.5 for tomosynthesis and regular mammography respectively. Multiplicity was better demonstrated by contrast mammography equally with sensitivity of 92% followed by tomosynthesis (77%) and regular mammography (54%). The combined analysis of the three modalities provided an estimated accuracy of 88% in the pre-operative evaluation of breast cancer.

CONCLUSION

The combined application of tomosynthesis and contrast-enhanced digital mammogram enhance the performance of the standard mammogram and present an informative method in staging breast cancer.

CLINICAL RELEVANCE/APPLICATION

Digital mammography (DM) is still limited by overlapped densities that may provide false negative/positive diagnosis. Advanced applications of DM: tomosynthesis and contrast-enhanced mammography could improve the performance and provide better evaluation of breast lesions.

VSBR31-06

DBT Technique

Martin J. Yaffe PhD (Presenter): Research collaboration, General Electric Company Founder, Matakina International Ltd Shareholder, Matakina International Ltd Co-founder, Mammographic Physics Inc
LEARNING OBJECTIVES

1) To review the basic principles of digital breast tomosynthesis (DBT). 2) Identify factors that may impact image quality and interpretation.

VSBR31-07
Dosimetric Properties of a Clinical DBT System: Relative Dose Contributions of 2D vs. 3D Exposures for Varying Breast Density

Laurie Lee Fajardo MD, MBA (Presenter): Scientific Advisory Board, Hologic, Inc Scientific Advisory Board, Koninklijke Philips NV, Limin Yang MD, PhD: Nothing to Disclose, Mark Bennett Williams PhD: Institutional research agreement, Hologic, Inc.

PURPOSE

To characterize the dosimetric properties of clinical digital breast tomosynthesis (DBT) systems during a single combo (2D + 3D) scan in a screening environment.

METHOD AND MATERIALS

Mean glandular radiation dose as recorded in the DICOM header was extracted for 950 asymptomatic patients (mean age 56.3 yrs; range 28 - 90 yrs) undergoing routine 2D + 3D combo breast screening (CC and/or MLO compressions, 3449 breasts) on one of two Hologic Dimensions systems. Dose was evaluated as a function of compressed breast thickness (CBT). Analysis was performed for individual BIRADS tissue density categories as determined by expert radiologists.

RESULTS

BIRADS breast tissue density among the study group was: almost entirely fatty (11.1%); scattered fibroglandular densities (51.5%); heterogeneously dense (28.2%) and extremely dense (9.2%). CBT ranged from 1.4 - 10.7 cm (mean = 6.0 cm). For 2D images with CBT < 7 cm (n = 2610), a tungsten/rhodium anode/filter combination was used with dose ranging from 0.54 - 4.49 mGy (mean = 1.62 mGy). For 2D images with CBT > 7 cm (n = 839), tungsten/silver anode/filter combination was used and dose ranged from 1.43 - 4.88 mGy (mean = 2.46 mGy). For DBT images, a tungsten/aluminum anode/filter was used for all compressed thicknesses (n = 3449) with dose ranging from 0.94 - 4.69 mGy (mean = 2.39 mGy). The total dose for a 2D+3D combo exam ranged from 1.56 mGy - 8.88 mGy (mean = 4.12 mGy), with 28 of 3504 (0.8%) combo exposures ≥ 3 mGy for breasts with CBT ≤ 4.2 cm. The relative dose contribution from the 2D and 3D portions of the scan changed monotonically with changing BIRADS classification, with 3D+2D dose ratio increasing from ~1 for extremely dense breasts to > 1.5 for fatty breasts.

CONCLUSION

Based on current automatic exposure control algorithms used in DBT, reconstructing 2D images from DBT projection images will reduce radiation dose by ~50% for dense breasts and ~40% for fatty breasts, enabling opportunities to refine the dosimetric properties of DBT and improve image quality.

CLINICAL RELEVANCE/APPLICATION

Breast screening using 2D + 3D combo DBT has demonstrated improved breast cancer detection and reduced FP (recall) rates. Dose in the majority of combo exposures is ≥3mGy; thus, substituting “synthetic 2D” for conventional DM images affords opportunities to better refine the dosimetric properties and image quality of DBT.

VSBR31-08
Radiation Dose during Screening Digital Breast Tomosynthesis: Does Patient Age, Compression Thickness or Breast Tissue Density Matter?


PURPOSE

To evaluate the effects of compression thickness (thickness), breast tissue density (density), and age on mean glandular dose (MGD) received from screening 3D Digital Breast Tomosynthesis (DBT).

METHOD AND MATERIALS

This IRB approved retrospective study included all screening DBT exams performed at our institution from 1/1/2014 to 1/31/2014. Our DBT protocol included 2D and 3D acquisitions. Patient age, density as determined by interpreting radiologist; compression thickness (mm) and total MGD (TMGD, mGy) for the 2 standard (craniocaudal and mediolateral oblique) views per breast were recorded. TMGD was independently compared to thickness, density, and age using univariate and multivariate regression. Subgroup analysis for low vs high density (fatty and scattered vs heterogeneous and extremely dense) was performed.

RESULTS

There were 200 DBT exams with mean age of 56 ±10.0 years (range 35-78). 110 exams were low density [33 fatty (16.5%), 77 scattered (38.5%)] and 90 were high density [67 heterogeneous (33.5%), 23 extremely dense (11.5%)]. The average TMGD was 14.95 mGy and average thickness was 57.3 mm. When correlated with radiation dose, there was a positive correlation with thickness (r=+0.92), but weak correlation with
density \((r=+0.20)\) and age \((r=0.21)\). Thickness is a significant determinant of total radiation dose \((R^2=0.87)\) and with density \((R^2=0.04)\) and patient age \((R^2=0.04)\) to a lesser extent. Using the multivariate model, we found that all three variables were statistically significant and increased the ability to predict patient total radiation dose \((R^2=0.90)\). For low density, the average TMGD was 15.3 mGy and average thickness was 61.2 mm. For high density, the average TMGD was 14.23 mGy and average thickness was 52.6 mm. Thickness showed a stronger correlation with radiation dose for patients with less dense than more dense breasts \((less: r=+0.97, R^2=0.96; more: r=+0.91, R^2=0.85; p<0.0001)\), indicating that TMGD increases more quickly with an increase in thickness for patients with low density breasts than for patients with high density breasts.

CONCLUSION

Radiation dose received by patients undergoing screening DBT significantly correlates with patient's breast thickness, and less so with breast density and age.

CLINICAL RELEVANCE/APPLICATION

For patients undergoing screening DBT, breast thickness should be considered as an important contributor to overall radiation dose in addition to breast density and patient age.

**VSBR31-09 Assessing Radiologist Performance and Microcalcifications Visualization Using Combined 3D Rotating Mammogram (RM) and Digital Breast Tomosynthesis (DBT)**

Nachiko Uchiyama MD (Presenter): Nothing to Disclose, Hitomi Tani: Nothing to Disclose, Minoru Machida MD, PhD: Nothing to Disclose, Mari Kikuchi MD: Nothing to Disclose, Yasuaki Arai: Nothing to Disclose

PURPOSE

RM (rotating mammogram) generates a 3D overview rendering of a reconstructed DBT volume. The purpose of this study is to compare the diagnostic accuracy of FFDM and DBT using and not using RM and to determine whether DBT plus RM will contribute to the assessment of breast cancer.

METHOD AND MATERIALS

55 patients including 34 breasts with malignant and 76 normal or benign breasts were recruited. 6 dedicated breast imaging radiologists evaluated the images utilizing ROC analysis. The 55 patient cases were randomly divided into two groups: group A (28 patients) and group B (27 patients). First, FFDM from group A and DBT with and without RM from group B were evaluated. Second, DBT with and without RM from group A and FFDM from group B were evaluated. Each participant completed two reading sessions spaced 4 weeks apart to minimize recall bias. Modified BI-RADS and percentage probability of malignancy (POM) scale were used and the reader-specific area under the curves (AUC) were analyzed. In addition, the visualization of masses and microcalcifications as well as the appearance of noise were also compared and scored separately for each case in DBT and RM on a 4-point scale from 0 to 3.

RESULTS

For the BI-RADS scale, the average AUC for DBT plus RM was 0.907, DBT alone 0.901 and FFDM was 0.793. For POM, the average AUC for DBT plus RM was 0.915, DBT alone 0.907 and FFDM was 0.799. DBT plus RM demonstrated superior diagnostic accuracy compared with FFDM alone, as shown by significant difference in the average AUC \((p<0.05)\). In terms of average AUC, only a small improvement was seen by DBT plus RM compared to DBT alone. Difference in the average AUC in BI-RADS between DBT plus RM and DBT alone was 0.006 and in POM was 0.008. For all 14 cancers manifesting as microcalcifications, the visualization was significantly better on RM than DBT \((p<0.05)\).

CONCLUSION

With the RM parameter settings used in this study, the combination of DBT plus RM showed only small improvement compared to that of DBT alone in terms of ROC curve area, sensitivity and specificity. Adjunction of RM to DBT will offer the benefit of increased diagnostic accuracy and contribute to more accurate assessment of DBT alone. The visualization of microcalcifications was significantly better on RM than DBT.

CLINICAL RELEVANCE/APPLICATION

The RM could be used for improved 3D visualization of structures, e.g. microcalcifications, in DBT and could lead to faster DBT reading times.

**VSBR31-10 Comparison with Synthetic 2D Mammography Reconstructed from Digital Breast Tomosynthesis and Digital 2D Mammography for the Detection of T1 Breast Cancer**

Ji Soo Choi MD, PhD (Presenter): Nothing to Disclose, Boo-Kyung Han MD, PhD: Nothing to Disclose, Eun Young Ko MD, PhD: Nothing to Disclose, Eun Sook Ko MD: Nothing to Disclose, Soo Yeon Hahn MD: Nothing to Disclose

PURPOSE

To evaluate the interpretative performance of synthetic two-dimensional (2D) mammography (C-View) reconstructed from digital breast tomosynthesis (DBT) for detection and characterization of small invasive cancers, compared to digital 2D mammography (DM).

METHOD AND MATERIALS
This study consecutively enrolled 107 patients (mean age 52.1 years) with T1-stage invasive breast cancers (≤2cm in size, mean size 12.9±4.3 mm) confirmed by surgical excision from January to June 2013. For each patient, DM and DBT were performed, and C-View was reconstructed from each set of DBT slices. Three breast radiologists, blinded to histology, interpreted DM and C-view, and recorded visibility (four-point scale; 1 no visible finding, 2 low conspicuity, 3 medium conspicuity, 4 high conspicuity) and morphology of detected cancers. Diagnostic performance of C-View was compared with that of DM in terms of detectability and visibility. Subgroup analyses were performed according to mammographic density (dense 29/ non-dense 78).

RESULTS

There was no significant difference in detection sensitivity of T1 breast cancers between C-View (range 62.6-71.0%) and DM (60.7-71.0%) for all readers (P>0.05). The visibility scores of C-View and DM were also not significantly different for each observer (range of mean scores 2.6-2.9 for C-View, 2.4-2.9 for DM; P>0.05). Common presentation of detected cancers on both C-View and DM were irregular spiculated masses (67.7% vs. 69.0%) and microcalcifications (14.5% vs. 15.5%). In the subgroup analysis according to mammographic density, C-View and DM showed no significant difference in detectability and visibility of T1 breast cancers. These two modes of dense breast group showed lower detection sensitivity (range 53.8-65.4% for C-View, 51.3-65.4% for DM) and lower visibility scores (range of mean visibility score 2.3-2.7 for C-View, 2.1-2.7 for DM), compare to those of non-dense group (detection sensitivity 86.2% for C-View, 86.2% for DM; range of mean visibility score 3.2-3.4 for C-view, 3.1-3.5 for DM).

CONCLUSION

Diagnostic performance of C-View and DM are comparable for detection of T1 breast cancers. Therefore, our results indicate that C-view may eliminate the need for addition of DM during DBT-based screening.

CLINICAL RELEVANCE/APPLICATION

Synthetic 2D mammography may eliminate the need for addition of digital 2D mammography during DBT-based screening, and keep the dose of DBT the same as that of digital 2D mammography.

VSBR31-11
Clinical Evidence of DBT Utility

Etta D. Pisano  MD (Presenter): Founder, NextRay, Inc CEO, NextRay, Inc Research Grant, Koninklijke Philips NV Research Grant, Zumatek, Inc Research Grant, FUJIFILM Holdings Corporation Equipment support, Siemens AG Research Grant, Siemens AG Equipment support, Koninklijke Philips NV Research Grant, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Review research data on the clinical utility of digital breast tomosynthesis (DBT). 2) Identify current gaps in evidence and directions for future research for DBT.

VSBR31-12
The STORM II (Screening with Tomosynthesis or Mammography II) Trial: Interim Comparison of Screen-reading Strategies in Population Breast Screening

Daniela Bernardi MD (Presenter): Nothing to Disclose , Marco Pellegrini MD : Nothing to Disclose , Marvi Valentini MD : Nothing to Disclose , Carmine Fanto MD : Nothing to Disclose , Nehmat Houssami MBBS : Nothing to Disclose

PURPOSE

To compare, in population breast screening, detection using various screening modalities including integrated synthetically reconstructed 2D images (synt2D) and 3D mammography (3D) with conventional mammography screening and integrated standard 2D and 3D.

METHOD AND MATERIALS

STORM II trial is a prospective study comparing 2D-only mammography with integrated 2D/3D and with integrated synthetic 2D images/3D. From June to November 2013, all the resident women aged from 49 to 70 who attended local population-based screening, after informed consent, had digital mammography in Combo® mode; synthetic 2D images were reconstructed from the data acquired during the tomo-exposures using dedicated software (Syntview®, Hologic, USA). All screens had independent, double and sequential readings: two readers interpreted sequentially 2D then 2D/3D, whereas two other readers interpreted sequentially synt2D then synt2D/3D, thus each screen was read by 4 readers. Any positive screens at any reading phase was recalled. Paired data were compared using McNemar’s Chi-square test.

RESULTS

Based on 3312 screens, 27 breast cancers were detected in 24 women: 19 cancers were detected by standard 2D mammography, 21 cancers were detected with integrated 2D/3D screening (p=0.50) whereas 6 more cancers were detected only by integration of synthetic 2D/3D (p=0.125). None of the cancers were detected with 2D-only mammography or synt2D alone. There were 295 false positive (FP) recalls attributed to various screen-reading modalities: 30 from synt2D alone, 33 from standard 2D mammography alone, 91 from synt2D/3D alone and 100 from 2D/3D alone. FP recalls for the integrated readings was 155 using integrated 2D/3D versus 151 using integrated synt2D/3D (p=0.79).

CONCLUSION

Although not statistically different from 2D/3D, cancer detection was highest for integrated synthetic 2D with 3D mammography amongst various screen-reading methods evaluated in this interim analysis.

CLINICAL RELEVANCE/APPLICATION
Integrated 2D/3D mammography may have the potential to enhance cancer detection in population breast screening providing a solution to concerns about the required double x-ray exposure in 2D/3D modality.

**Interval Cancers in Patients Screened with Full Field Digital Mammography (FFDM) vs FFDM plus Digital Breast Tomosynthesis (DBT)**

**Nelly Salem MD (Presenter): Nothing to Disclose, Cheryl L Thompson: Nothing to Disclose, Donna M. Plecha MD : Advisory Board, Hologic, Inc Research Grant, SuperSonic Imagine**

**PURPOSE**

To compare the rates and tumor characteristics of interval cancers diagnosed in patients screened with full field digital mammography (FFDM) versus those screened with FFDM plus digital breast tomosynthesis (DBT).

**METHOD AND MATERIALS**

Cancer patients diagnosed from 9/1/2011-12/31/2013 were evaluated, determining if they were interval cancers from a population screened from 9/1/2011-12/31/2012. Patients were separated into two groups: those who were screened with FFDM versus FFDM + DBT. Interval cancers were defined as those that presented less than a year of a negative screening mammogram with a symptom. Age, breast density, interval time period from a negative mammogram, tumor size, stage, lymph node status, and treatment regimens were recorded.

**RESULTS**

15,551 women were screened between 9/1/2011 and 12/31/2012 with 11,185 screened with FFDM and 4,366 women screened with FFDM + DBT. Overall 22 interval cancers were identified, 18 were patients who underwent screening with FFDM, and 4 were screened with FFDM + DBT. This is a non-significant 38% lower interval cancer rate of 1 cancer per 1000 patients screened with FFDM + DBT versus 1.6/1000 interval cancers in patients screened with FFDM alone (p=0.43). Overall mean cancer patient age was 62, and there was a mean of 7.7 months interval at time of diagnosis since the screening exam, with no significant difference between the two groups. When comparing the two groups of interval cancer patients, there was no statistical significance in breast density, cancer grade, stage, size, lymph node status, mastectomy rate, rate of chemotherapy or radiation therapy between the two groups.

**CONCLUSION**

Our results show a non-significant 38% lower interval cancer rate when screening with FFDM + DBT versus FFDM alone. We found no significant difference between the two groups of interval cancer patients comparing age, breast density, interval time at diagnosis, cancer grade, stage, size, lymph node status, mastectomy rate, rate of chemotherapy or radiation therapy.

**CLINICAL RELEVANCE/APPLICATION**

DBT is a promising supplement to mammographic screening for breast cancer. Studies have shown decreased recall rates and increased cancer detection rates, however the effect on interval cancers has not been evaluated. Our results demonstrate no significant difference in: the interval cancer rate or characteristics of the interval cancers between patients screened with DBT + FFDM versus FFDM alone.

**Comparison of the Use of BIRADS Category 3 before and after Implementation of Digital Breast Tomosynthesis in a Large Screening Population**

**Elizabeth McDonald MD, PhD (Presenter): Nothing to Disclose, Susan Weinstein MD : Nothing to Disclose, Anne Marie McCarthy : Nothing to Disclose, Marie Synnestvedt : Nothing to Disclose, Mitchell Dennis Schnall MD, PhD : Nothing to Disclose, Emily F. Conant MD : Scientific Advisory Board, Hologic, Inc**

**PURPOSE**

(1) Compare the utilization of BIRADS category 3 (BR3, recommend short-interval follow-up) after a recall from screening before and after implementation of screening digital breast tomosynthesis (DBT). (2) Determine whether DBT will reduce the use of short-interval follow-up by lesion subtype.

**METHOD AND MATERIALS**

Retrospective IRB approved review of 15,633 screening DBT exams from 10/1/2011-2/28/2013 and 10,751 screening digital mammography (DM) exams from 9/1/2010-8/30/2011 was performed. The initial recall populations for DM and DBT were 1116 and 1372, respectively. That group was further searched for a de novo assignment of category 3. Exams were cataloged according to finding type: calcifications (C), asymmetry or focal asymmetry (A), mass (M), and architectural distortion (AD). Some exams were recalled for more than one finding type. Differences between groups were compared using Wilcoxon Rank Sum Test.

**RESULTS**

There were significantly less patients recommended for short-interval follow-up in the DBT cohort (172/10751, 1.6% DM versus 203/15633, 1.3% DBT, p=0.042). However, this difference was no longer significant when the lower recall rate of the DBT cohort was taken into account (172/1116, 15.4% DM versus 203/1372, 14.8% DBT, p=0.70). The finding types given a BR3 for the DM cohort were C (67/172, 39.0%), M (41/172, 23.8%), A (71/172, 41.3%), and AD (5/172, 2.9%) and DBT cohort, C (66/203, 32.5%), M (62/203, 30.5%), A (96/203, 47.2%).
47.3%) and AD (9/203, 4.4%). There was no significant difference in the use of BR3 for any finding type (p=0.20, 0.15, 0.24 and 0.44, respectively).

CONCLUSION

Screening DBT does not reduce the frequency of BR3 assessment after recall from screening and also does not change the types of findings recommended for short-interval follow-up.

CLINICAL RELEVANCE/APPLICATION

Screening with DBT does not reduce the number of patients recommended for short-interval follow-up after initial diagnostic evaluation.

Cancer Yield of Architectural Distortion Detected on Screening Tomosynthesis

Kelly Damico MD (Presenter): Nothing to Disclose, Ana P. Lourenco MD : Nothing to Disclose, Luke M. Partyka MD : Nothing to Disclose, Martha Beretta Mainiero MD : Nothing to Disclose

PURPOSE

To determine the cancer yield of architectural distortion (AD) seen only or better on digital breast tomosynthesis (DBT) compared to digital mammography (DM) during routine screening.

METHOD AND MATERIALS

An IRB approved, HIPAA compliant retrospective review of all screening DBT performed at an academic breast center from March 2012 through November 2013 identified all BIRADS 0 results. BI-RADS 0 reports were then reviewed to identify all cases of AD or possible AD. Cases were consensus reviewed by two fellowship trained breast radiologists and scored according to visibility of the AD (seen only on DM, better on DM, equally on DM and DBT, better on DBT, or only on DBT). All additional imaging and pathology results corresponding to the AD were reviewed, and results recorded in a database.

RESULTS

Of the 25,369 screening DBT exams, there were 1,769 (7%) BI-RADS 0 results. Of these, there were 84 (4.7%) reports of AD or possible AD. 32 were excluded, as AD or possible AD was not confirmed on consensus review. 52 cases of AD or possible AD detected at screening form the basis of this study. Of these, 26 (50%) were seen only on DBT, 23 (44%) seen better on DBT than DM, and 2 (4%) seen equally on DBT and DM. There were no cases seen only or better on DM. Of the 52 cases, 26 went on to biopsy (50%) with malignancy diagnosed in 54% (14/26) (biopsy positive predictive value). Biopsy also identified 7 radial scars and 5 benign findings. All 26 of the biopsied cases were either seen only on DBT or seen better on DBT. Of the malignancies, 57% (8/14) were DBT only findings. Surgical excision was required in 81% (21/26) of cases biopsied. Of the 26 cases that did not undergo biopsy, 8 (31%) were assessed as BI-RADS 3 and 13 (50%) as BI-RADS 1/2 on diagnostic evaluation. 1 case was lost to follow-up. 4 cases were assessed as BI-RADS 4/5 for lesions separate from the possible AD. Average follow-up for lesions not undergoing biopsy was 9.7 months. Overall cancer yield was 27% (14/52).

CONCLUSION

DBT detects areas of malignant AD not readily seen on DM. The 27% cancer yield in this study suggests that AD should not be dismissed even if detected only on DBT.

CLINICAL RELEVANCE/APPLICATION

The cancer yield and biopsy positive predictive value of AD detected only on DBT is high. This finding should not be dismissed when identified at routine screening DBT.

Comparison of Digital Mammography (FFDM) and FFDM Plus Digital Breast Tomosynthesis in Mammography Screening for Cancer Detection according to Breast Parenchyma Density


PURPOSE

To compare cancer detection using full-field digital mammography (FFDM) versus FFDM plus digital breast tomosynthesis (DBT) in a population-based screening according to BI-RADS density.

METHOD AND MATERIALS

The prospective screening trial was approved by Ethical Committee. All women signed a written consent. 25,547 women age 50-69 y. underwent FFDM and DBT. Prospective independent readings were performed, using a 5-point rating scale for probability of cancer (1-5) for each breast. Eight radiologists participated in the
interpretation alternating between the two modes. The trial had 4 arms including one arm offering FFDM+CAD and another offering synthetic 2D in lieu of conventional FFDM. This analysis includes only two arms, namely FFDM alone versus FFDM+DBT. All cases with a positive score by at least one reader were discussed at arbitration meeting before final decision whether to recall the woman for diagnostic workup. At arbitration meeting case-based consensus BI-RADS density scores were recorded. Cancers detected on FFDM and FFDM+DBT were stratified by breast density. McNemar test was used to compare detection in each of the density groups by mode.

RESULTS

257 screen-detected malignancies were found: 20 in breasts with density 1; 105 in density 2; 110 in density 3; and 22 in breasts with BI-RADS density 4. Overall, a true positive (TP) score under the FFDM alone mode was 163/257 (63%) compared with 211/257 (82%) under the FFDM+DBT mode (p<0.05). For women with “fatty breast” (BI-RADS density 1 or 2), the number of cancers detected by FFDM alone and FFDM+DBT were 85/125 (68%) and 105/125 (84%), respectively (p<0.05) and in women with “dense breast” (density 3 or 4), the detected cancers were 78/132 (59%) and 106/132 (80%), respectively (p<0.05). Stratifying the “fatty breast” into BI-RADS density 1 and 2 showed no difference in detection between FFDM and FFDM+DBT in BI-RADS density 1 (17/20 versus 16/20 detected cancers, respectively). The higher detection rate in “fatty breasts” by FFDM+DBT was solely attributed to higher detection in women with breast density 2.

CONCLUSION

Tomosynthesis has the potential to significantly increase the cancer detection rate in mammography screening of women with breast density BI-RADS 2-4. We observed no increase in women with BI-RADS density 1.

CLINICAL RELEVANCE/APPLICATION

Tomosynthesis may significantly improve the cancer detection rate in mammography screening of women with BI-RADS density 2-4.

Screening Recalls after Tomosynthesis Mammography: Are Additional Mammographic Views Necessary?

Jaime Lynn Geisel MD (Presenter): Consultant, Siemens AG , Liva Andrejeva-Wright MD : Nothing to Disclose , Madhavi Raghu MD : Nothing to Disclose , Melissa Angeline Durand MD : Nothing to Disclose , Paul H. Levesque MD : Nothing to Disclose , Liane Elizabeth Philpotts MD : Nothing to Disclose

PURPOSE

Tomosynthesis (tomo) has been shown to reduce recalls from screening mammography and be equivalent or superior to conventional (2D) spot views. The value of spot tomo views has not yet been assessed. The purpose of our study is to determine in what lesions is additional diagnostic mammographic imaging beneficial.

METHOD AND MATERIALS

A retrospective review of the breast imaging database was performed to identify all BIRADS 0 cases in patients undergoing tomosynthesis screening in a 6 month period, July 1, 2013 to December 31, 2013. Of 295 BIRADS 0 lesions, 157 lesions in 138 patients who had tomo spot views and US as part of the diagnostic work-up were included. Cases were retrospectively blindly reviewed on a dedicated workstation by 4 readers. Two readers evaluated each lesion for a total of 314 lesion assessments. Readers evaluated the screening tomosynthesis exam, followed by the US images and finally the additional diagnostic spot tomo views. The type of lesion (asymmetry, mass, architectural distortion), breast density, forced BIRADS and likelihood of malignancy were assessed at each stage. The outcome of cases in terms of final BIRADS assessment and biopsy results, when appropriate, was assessed.

RESULTS

The mammographic findings consisted of 182 asymmetries, 83 masses, and 49 architectural distortions. In 226 (72%), additional spot tomo views were assessed as not helpful to screening tomosynthesis. Spot views were reported helpful in assessing 57% (28/49) architectural distortions, 25% (45/182) asymmetries and 18% (15/83) masses. Spot views were considered more helpful in assessing lesions noted on one view only (41%), the majority of which were asymmetries (75%) and architectural distortions (20%), compared with two views (17%). Readers identified all 9 cancers with tomo and US. No additional cancers were detected with spot tomo views.

CONCLUSION

Spot tomosynthesis views did not add to the diagnostic evaluation in the majority of non-calcification cases recalled from tomosynthesis screening but were useful in many cases of questioned architectural distortion. The overall sensitivity of screening tomo and US alone was equivalent to that with spot images.

CLINICAL RELEVANCE/APPLICATION

Routine screening tomosynthesis views allow adequate assessment of most mammographic findings such that US alone is required in the work up of the majority of cases recalled from screening which can save costs, radiation, exposure and time.
Quantitative CT for Interstitial Lung Disease
Jonathan G. Goldin MBChB, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Review the approaches for detecting and quantifying lung changes in IPF. 2) Understand the predictive value of disease quantitation with respect to survival and outcome. 3) Become familiar with the role of change in quantitative measures at follow up both in the setting of clinical trials and practice.

Quantification of Interstitial Lung Disease in Idiopathic Inflammatory Myopathy Patients Using the “Computer-Aided Lung Informatics for Pathology Evaluation and Rating” (CALIPER) Software System
Katelynn Maries Wilton BS (Presenter): Nothing to Disclose, Brian Jack Bartholmai MD : Nothing to Disclose, Sanjay Kalra MD : Nothing to Disclose, Cynthia S. Crowson MS : Nothing to Disclose, Sushravya Raghunath : Nothing to Disclose, Srinivasan Rajagopalan PhD : Nothing to Disclose, Floranne Ernste MD : Nothing to Disclose

PURPOSE
In idiopathic inflammatory myopathy (IIM), interstitial lung disease (ILD) is a major cause of morbidity and mortality. ILD in IIM may manifest with a variety of pathological and radiographic abnormalities. Most ILD subtypes have characteristic clinical and radiographic features; hence, diagnosis is usually aided by expert radiologist assessment. Radiography and pulmonary function tests (PFT) may provide a qualitative measurement of severity. However, CT evaluation is subject to inter- and intra-observer variability. PFT results can be influenced by patient effort and do not differentiate specific restrictive pulmonary pathologies. We hypothesize that Computer-Aided Lung Informatics for Pathology Evaluation and Rating (CALIPER) software, which characterizes CT parenchyma, can help predict clinical outcomes, objectively quantify extent of ILD in IIM and help in disease monitoring.

METHOD AND MATERIALS
CALIPER was utilized to quantify ILD features on CT in 172 subjects with IIM. We retrospectively collected demographic, PFT and medication data at baseline, years 1, 3 and 5. IIM-related mortality was retrospectively assessed.

RESULTS
CALIPER detected diverse parenchymal involvement, with variable quantities of uninvolved parenchyma, ground glass opacities, reticular densities, honeycombing and low attenuation areas. In 95% of patients, CALIPER detected ≥5% parenchymal abnormalities characteristic of ILD. Compared to treated patients, untreated patients had more baseline parenchymal abnormalities. The treated cohort showed improvement in quantity of reticular densities (year 1, 3) and total interstitial abnormalities (year 1), while our untreated subgroup showed worsening interstitial abnormalities (year 3).

CONCLUSION
CALIPER analysis, including identification and quantification of baseline ILD and detection of change, in parenchymal involvement may prove to be a useful clinical tool in patients with IIM.

CLINICAL RELEVANCE/APPLICATION
Detection and monitoring of ILD progression in patients with IIM can better inform the use of immunomodulatory treatments, both in the clinic and in future research trials.

Quantitative CT for COPD
Alexander A. Bankier MD, PhD (Presenter): Author with royalties, Reed Elsevier Consultant, Olympus Corporation
LEARNING OBJECTIVES

1) To review quantitative CT techniques for airway and parenchyma assessment in patients with COPD. 2) To discuss the potential and limitations of these techniques. 3) To review how these techniques can impact on the clinical management of patients with COPD.

Quantitative CT Can Define Clinically Different Subgroups of Cigarette Smokers


PURPOSE

To determine in a population of cigarette smokers whether distinct subgroups defined by quantitative CT measures of emphysema and gas trapping differ in symptoms, quality of life, or exacerbation frequency.

METHOD AND MATERIALS

We studied 8144 current or former cigarette smokers enrolled in the COPDGene® study. All underwent inspiratory and expiratory volumetric CT with automated quantification of % low attenuation areas (LAA) for estimation of emphysema and gas trapping, using thresholds of -950 on inspiratory CT (LAA-950 insp) and -856 on expiratory CT (LAA-856 exp). Normal cutoff values for these parameters, based on 92 normal subjects, were 5.8% for % LAA-950insp, and 24.3% for % LAA-856exp. Cutoff values were adjusted for current smokers. Dyspnea was evaluated by MMRC questionnaire, respiratory symptoms by St George Respiratory Questionnaire, and quality of life by SF-36 questionnaire. We used binary recursive partitioning (tree function in R) to identify subgroup differences in clinical outcomes.

RESULTS

Of the 8144 subjects, 768 (9%) met criteria for emphysema without gas trapping (“emphysema”), 579 (7%) had gas trapping without emphysema (“gas trapping”), 2413 (30%) had mixed gas trapping and emphysema, and 4384 (54%) did not meet criteria for emphysema or gas trapping. Compared with the emphysema group, the gas trapping group was significantly older, had shorter 6 minute walk distance, higher frequency of exacerbations, and had higher scores for dyspnea, respiratory symptoms, and physical component of SF-36. When binary recursive partitioning was used, a cutoff value of approximately 40% for gas trapping identified dichotomous subgroups of severity, assessed by FEV1% predicted, FEV1/FVC ratio, MMRC score, 6 minute walk distance, exacerbation frequency, and St George Respiratory questionnaire.

CONCLUSION

Quantitative CT assessment of emphysema and gas trapping identifies subgroups of subjects with clinically significant differences in disease severity.

CLINICAL RELEVANCE/APPLICATION

Quantitative CT may be used to identify important clinically important subtypes of COPD.

CT: Innovations for Dose Reduction

Narinder S. Paul MD (Presenter): Research funded, Toshiba Corporation

LEARNING OBJECTIVES

1) Discuss the latest approaches to low dose and ultralow dose thoracic CT. 2) Understand the prioritization of X-ray exposure factors for different CT chest protocols. 3) Appreciate the role of Iterative Reconstruction algorithms in low dose and ultralow dose chest CT. 4) Understand the approach to compressive sensing algorithms in low dose and ultralow dose chest CT.

ABSTRACT

This refresher course will provide a comprehensive review of the latest approaches to low dose and ultralow dose chest CT

Assessment of Image Based, Adaptive Statistical, and Model Based Iterative Reconstruction Techniques for Chest CT at Less than 1 mGy CTDIvol

PURPOSE
To assess image quality of chest CT reconstructed with image based (SafeCT), adaptive statistical (ASIR), and model based (MBIR) iterative reconstruction techniques (IRT) at less than 1 mGy CTDIvol.

METHOD AND MATERIALS
Our IRB approved prospective study included 23 patients (mean age 63±13 years, 80±18 kg, M:F18:5) who underwent routine chest CT on a 64 channel MDCT (GE Discovery CT750 HD) and gave written informed consent for acquisition of ultra low dose (ULD) chest CT series. Standard chest CT (8±3.4 mGy) was followed by 3 ULD chest image series (0.2, 0.4, and 0.8 mGy) (total additional dose <1 mSv). Images were used to reconstruct SafeCT (CH0, CH1) and sinogram data were used to reconstructed with ASIR (SS70, SS90) and MBIR and standard CT with ASIR (SS40) (n=23*3*5+23=368 series). Board-certified thoracic radiologists performed independent and blinded evaluation for lesion detection, lesion conspicuity, and visibility of small structures from lowest to highest dose of ULD series and subsequently for standard dose CT.

RESULTS
Of 182 lesion, 112 non-calcified lung nodules (LN) and 8 ground glass opacities (GGO). There were 34 missed lesions [24 LN, 4GGO, 2 thyroid nodule (TN), 3 pleural effusions (PL)] at 0.2 mGy, 27 [18 LN, 2GGO, 2TN, 2 PL] at 0.4 mGy, and 11 [3LN,2GGO, 2TN, 2PL] at 0.8 mGy. The size of missed LN was less than 4mm. There were 7 and 4 false positive lesions at 0.2 and 0.4 mGy, respectively but none at 0.8 mGy. The conspicuity of LN was sufficient for diagnostic performance for 3/19 at 0.2 mGy, 6/19 at 0.4 mGy and 10/17 (SafeCT:10,ASIR:10,MBIR:7) at 0.8 mGy. Visibility of sub-segmental bronchi was suboptimal at 0.2 and 0.4 mGy but sufficient for 11/23 with IRT. Visibility of mediastinal and axillary lymph nodes was suboptimal at 0.2 and 0.4 mGy but sufficient for 9/23 with SafeCT, 8/23 with ASIR, 14/23 with MBIR at 0.8 mGy. Visibility of other mediastinal structures was limited at 0.8 mGy and suboptimal at 0.2 and 0.4 mGy.

CONCLUSION
Most clinically significant lung lesions can be detected at CTDIvol of 0.8 mGy with SafeCT, ASIR, and MBIR. However, mediastinal structures could not be assessed with sufficient diagnostic confidence at 0.2-0.8 mGy with any IRT.

CLINICAL RELEVANCE/APPLICATION
Lung nodules >4mm can be assessed with IRT at CTDIvol as low as 0.2 mGy but those < 4mm can be missed at CTDIvol less than 0.8 mGy regardless of the IRT.

V SCH31-07 CT: Applications of Spectral Imaging
Martine J. Remy-Jardin MD, PhD (Presenter): Research Grant, Siemens AG

LEARNING OBJECTIVES
1) To make radiologists familiar with a daily use of spectral imaging. 2) To describe the clinical usefulness of this imaging modality. 3) To discuss the possibility of applying dual energy for routine chest CT.

V SCH31-08 MR: State of the Art
Hiroto Hatabu MD, PhD (Presenter): Research Grant, Toshiba Corporation Research Grant, AZE, Ltd Research Grant, Canon Inc

LEARNING OBJECTIVES
1) Understand reasons for the renewed interest in thoracic MR. 2) Be familiar with current and emerging clinical applications of MR imaging in the chest. 3) Become acquainted with recently developed MR approaches to chest imaging. 4) Be aware of investigational MR methods for imaging lung function.

ABSTRACT
Thoracic MRI, exclusive of cardiovascular imaging, has evolved through stages of initial enthusiasm followed by limited clinical utilization for specific applications. Examples of the latter have included differentiation of thymic hyperplasia vs lymphoma, characterization of mediastinal duplication cysts, neurogenic/thoracic spinal lesions, cardiac/paracardiac masses, evaluation of superior sulcus tumors and the brachial plexus, staging mesothelioma, and evaluating primary chest wall lesions. Ongoing advances in CT in combination with the relative complexities of MR and its suboptimal visualization of the pulmonary parenchyma have continued to restrict the use of MR in the chest. However, there has been a recent resurgence of interest in thoracic MR based upon the development of practical protocols for improved lung imaging with faster proton MR sequences, parallel imaging, non-gadolinium MRA, etc. coupled with increased concern regarding radiation exposure with CT. This presentation will provide an overview of current and emerging clinical applications of nonvascular thoracic MR (including diffusion and whole body MR tumor imaging and the recent introduction of PET-MR), present an update on investigational techniques for imaging lung function including hyperpolarized gas MR, and serve as an introduction to these topics covered in further detail by the refresher course faculty.

V SCH31-09 MR: Practical Proton and Perfusion Imaging
Scott K. Nagle MD, PhD (Presenter): Stockholder, General Electric Company Research Consultant, Vertex Pharmaceuticals Incorporated

LEARNING OBJECTIVES
1) Identify the basic MR pulse sequences for clinical evaluation of lung structure. 2) Explain the advantages of using 3D radial ultrashort echo time MRI to image the lung. 3) List the critical scan parameters for robust evaluation of lung perfusion using time-resolved contrast-enhanced MRI.

ABSTRACT

Although many small studies have suggested a useful role for MRI in imaging lung structure and perfusion, it has yet to see widespread use. Because CT is well-established as the primary cross-sectional imaging modality for the lungs, most thoracic radiologists are much more comfortable with CT than they are with MRI. This has hindered the translation of lung MRI protocols into clinical practice. However, MRI offers the potential of greater soft tissue contrast and the ability to assess both lung structure and function without the need for ionizing radiation. The purpose of this presentation is to familiarize the thoracic radiologist with the existing MRI methods for imaging both lung structure and perfusion, to highlight how emerging methods such as 3D radial ultrashort echo time MRI may improve the performance of lung MRI, and to suggest clinical scenarios in which thoracic MRI may be most useful.

V SCH31-10

Computed Diffusion-weighted Imaging with High b-Value: How to Apply for Improving Pulmonary Nodule/Mass Assessment Capability with Acquired Diffusion-weighted Imaging

Hisanobu Koyama MD, PhD (Presenter): Nothing to Disclose , Yoshiharu Ohno MD, PhD : Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd Research Grant, Terumo Corporation Research Grant, Fujifilm Holdings Corporation Research Grant, Guerbet SA , Shinichiro Seki : Nothing to Disclose , Mizuho Nishio MD, PhD : Research Grant, Toshiba Corporation , Takeshi Yoshikawa MD : Research Grant, Toshiba Corporation , Sumiaki Matsumoto MD, PhD : Research Grant, Toshiba Corporation , Masato Masaeda : Employee, Toshiba Corporation , Yu Ueda PhD : Nothing to Disclose , Katsusuke Kyotani RT : Nothing to Disclose , Kazuhiro Kubo RT : Nothing to Disclose , Kazuo Sugimura MD, PhD : Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

PURPOSE

Computed diffusion-weighted imaging (cDWI) is the newly proposed method to generate DWI with arbitrary b-values from acquired DWIs (aDWIs) with different b values. The purpose of this study is to directly and prospectively compare capabilities for pulmonary nodule/mass detection and differentiation of malignant from benign lesions among cDWI and aDWIs.

METHOD AND MATERIALS

Ninety-seven patients (64 men and 33 women, mean age 69.1 years) with 121 pulmonary nodules/masses (mean diameter: 28.9mm, median: 24mm) underwent DWI with b values at 0, 500 and 1000 s/mm2 by 1.5 T MR system. According to pathological and/or follow up examinations, these pulmonary lesions were divided into malignancy (n=97) and benign (n=24). Then, cDWI with b value at 1,000 s/mm2 was computedly generated from aDWIs with b-values at 0 and 500 s/mm2 by our propriety software. To evaluate detection capability of DWI, aDWI500 with b values at 500 s/mm2 (aDWI500) and 1,000 s/mm2 (aDWI1000) and cDWI1000 were visually assessed by means of 5-points scoring system. For quantitative diagnosis of pulmonary lesion, lesion to spinal cord ratio (LSR) on each DWI was calculated. To evaluate the detection capability, detection rate was compared among aDWI500, aDWI1000 and cDWI1000 by McNemar’s test. To determine the optimal threshold value for differentiation, ROC analysis was performed, and the area under the ROC curve (AUC) was compared by McNemar’s test. The detection rate of aDWI500 without cDWI1000 was 100% (99.2%, p<0.05) was significantly higher than that of aDWI1000 (92.6%, p>0.05). However, there was no significant difference with that of cDWI1000 (97.6%, p>0.05). The SE and AC of aDWI500 were significantly higher than those of aDWI1000 and cDWI1000 (p>0.05).

RESULTS

The detection rate of aDWI500 (99.2%) was significantly higher than that of aDWI1000 (98.6%, p<0.05), however no significant difference with that of cDWI1000 (97.6%, p>0.05). There was no significant difference among aDWI500 without cDWI1000 (SE; 72.6%, and AC; 70.3%), aDWI500 (SE; 72.6%, and AC; 71.9%) and cDWI1000 (SE; 78.5%, and AC; 75.2%). However, the SE and AC of aDWI500 with cDWI1000 (SE; 80.4%, and AC; 76.9%) were significantly higher than those of aDWI500 without cDWI1000 and aDWI1000 (p<0.05).

CONCLUSION

Computed DWI was useful technique, and the combination of aDWI500 with cDWI1000 would be better to choose in clinical practice for the evaluation of pulmonary nodules/masses.

CLINICAL RELEVANCE/APPLICATION

Computed DWI with high b value added to really acquired DWI with a relatively low b value improves the diagnostic capabilities for the evaluation of pulmonary nodule/mass.

V SCH31-11

MR: Building a Clinical Program

Jeanne B. Ackman MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Learn why nonvascular thoracic MRI has been underutilized despite proven advantages in tissue characterization (e.g. mediastinal masses) and its absence of ionizing radiation. 2) Learn what should be done to increase its utilization to an appropriate level for good patient care. 3) Learn the various components required to build and maintain a successful nonvascular thoracic MRI practice.

IMPROVE.
Nonvascular thoracic MRI has been underutilized despite proven advantages in tissue characterization and its absence of ionizing radiation because of insufficient nonvascular thoracic MR training during residency and fellowship, a resultant lack of recognition of its value to patient care, and a resultant discomfort in recommending, protocolling, and interpreting thoracic MR studies. Improved education of trainees, technologists, and radiologists is needed to increase its utilization to an appropriate level for good patient care. Nonvascular thoracic MRI can be cost-effective when considered in the context of the full care cycle of the patient. The various components required to build a successful nonvascular thoracic MRI practice, include: 1) continuous development and maintenance of updated MR protocols, 2) continuous sharing of these updated protocols with one's radiology group, 3) MRI technologist training with regard to thoracic anatomy, cardiac gating, and successful breath-hold imaging, 4) education of referring physicians about the value of nonvascular thoracic MRI to their practice, 5) facilitation of ordering of these MR examinations via computer order entry, 6) creation of structured reporting voice recognition Macros to facilitate reporting by trainees and staff, 7) sharing of interesting and instructive MRI cases at weekly conferences, 8) a quality assurance initiative.

**Hyperpolarized 129Xe Gas-Transfer Spectroscopy and Imaging: Initial Experience in Patients with Idiopathic Pulmonary Fibrosis (IPF)**

Justus E. Roos, MD (Presenter): Nothing to Disclose, Sivaram Kaushik, MS: Nothing to Disclose, H. Page McAdams, MD: Research Grant, General Electric Company Consultant, MedQIA Author, Reed Elsevier Author, UpToDate, Inc, Bastiaan Driehuys, PhD: Research support, General Electric Company, Royalties, General Electric Company Stockholder, Polarean, Inc

**PURPOSE**

Inhaled hyperpolarized 129Xe diffuses across the alveolar-capillary membrane and dissolves into two compartments: interstitium (barrier) and red blood cells (RBC). This results in an almost 200 ppm frequency shift in 129Xe resonance transfer. The aim of this study is to quantify global and regional pulmonary gas-transfer using hyperpolarized (HP) 129Xe gas transfer spectroscopy and MRI, in healthy volunteers and subjects with IPF.

**METHOD AND MATERIALS**

This IRB-approved and HIPAA compliant study was performed on a 1.5T GE clinical scanner. Gas transfer spectra were acquired in 11 healthy volunteers (HV) and 6 IPF subjects using 200-mL of HP 129Xe. Global gas-transfer was quantified using the ratio of the areas under the curves of the RBC and barrier resonance spectra. This RBC:Barrier ratio was correlated with DLCO. In two IPF subjects, 3D images of gas transfer to RBCs were reconstructed using a 1-point Dixon acquisition. Regional gas-transfer defects on RBC images were visually scored by dividing each lung into 16 regions (32 per subject). Presence or absence of 129Xe RBC signal in each region was correlated with the extent of fibrosis in the same region on CT (scored as none, mild, or severe fibrosis).

**RESULTS**

The RBC:Barrier ratio in IPF subjects was significantly reduced (0.16±0.03) when compared to healthy volunteers (0.55±0.13, p

**CONCLUSION**

Gas-transfer MR spectroscopy and imaging using HP 129Xe can detect global and regional diffusion impairment in IPF patients and may correlate with extent of pulmonary fibrosis depicted by CT. 129Xe MRI can provide a radiation-free method for sensitive assessment of regional gas transfer and may be a useful biomarker to assess response to therapy.

**CLINICAL RELEVANCE/APPLICATION**

Inhaled hyperpolarized 129Xe diffuses across the alveolar-capillary membrane and dissolves in the pulmonary red blood cells (RBC). This closely mimics the diffusion of O2 and hence imaging of 129Xe in RBCs can depict pulmonary gas exchange.

**MR: Assessing Lung Function**

Talissa A. Altes, MD (Presenter): Research Grant, Vertex Pharmaceuticals Incorporated Research Grant, Novartis AG Speaker, Koninklijke Philips NV Speaker, Guerbet SA

**LEARNING OBJECTIVES**

1) Understand the limitations of proton lung MRI and the strengths and weaknesses of hyperpolarized gas MRI of the lung. 2) Learn about potential research and clinical applications of hyperpolarized gas lung MRI in lung diseases such as CF, asthma, and COPD.

**19F Perfluoropropane/Oxygen Gas Contrast Enhanced MRI of Pulmonary Ventilation: Image Reduction, Analysis and Resulting Physiological Biomarkers**


**PURPOSE**

19Fluorine Gas MRI provides a dynamic assessment of pulmonary ventilatory function. The purpose of this work is to determine the extraction and generation of image based biomarkers of pulmonary ventilation for utilization in clinical trial and clinical settings.
METHOD AND MATERIALS

Imaging [45 Normals (28 Non smokers, 9 exsmokers, 8 smokers), 7 COPD] was performed on a Siemens TIM Trio 3T MRI scanner and consisted of conventional localizing scout and inspiratory/expiratory breath-held scans (1H) and 3D GRE-VIBE functional scans using Perfluoropropane/Oxygen gas mixtures (19F, TR/TE, 15/1.62 ms, NEX=2, Matrix=64x64, slice=15mm, pixel size=6.25x6.25 mm, flip angle= 70°). All acquisitions were performed at total lung capacity to facilitate anatomical correlation utilizing an in house developed gas delivery and subject monitoring apparatus. A total of at least 7 sequential breath holds were performed, interleaved with 3-4 breaths of the O2/PFP mixture (wash-in), or room air (wash-out). Using an in house developed python based script, all 3D masked [masked using Slicer (www.slicer.org)] lung volumetric image datasets were reduced to a single table representing the x,y and z coordinates and pixel value then concatenated to a 4D x,y,z,t,value table. Data analysis was accomplished using standard features of JMP (SAS Institute).

RESULTS

Image reduction facilitated the use of established statistical algorithms and functions to evaluate biomarkers. Each imaging session provides an array of ventilation assessments throughout the wash-in and wash-out times (seconds) of PFP gas including static and dynamic ventilation distribution, gas trapping, ventilation heterogeneity, ventilation defect persistence and clearance and regional efficiency of ventilation.

CONCLUSION

Dynamic evaluation of the pulmonary airspaces using PFP enhanced MRI provides a straight-forward and relatively inexpensive means for evaluating ventilatory heterogeneity and providing a spatio-temporal descriptor of "slow to fast filling compartments" in pulmonary disorders. Simplification of data reduction presents many avenues for generation of pulmonary ventilation based biomarkers to evaluate the integrity and functional status of the pulmonary airspaces.

CLINICAL RELEVANCE/APPLICATION

19F-Enhanced MRI of Pulmonary function using PFP gas facilitates dynamic quantitative and qualitative assessments of pulmonary ventilation and the generation of clinically viable imaging biomarkers.

VSGI31-15  MR: Imaging of Childhood Diseases
Edward Yungjae Lee MD, MPH (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review practical approach to pediatric patient preparation for thoracic MR imaging. 2) Discuss currently available MRI techniques for evaluating thoracic disorders in children. 3) Learn characteristic MRI findings to narrow the differential diagnoses of various thoracic childhood diseases.

Gastrointestinal Series: State-of-Art CT and MR in Luminal GI Diseases

VSGI31-01  Crohn's Disease
Amy Kiyo Hara MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) CT Enterography technique (Oral contrast and low radiation dose issues). 2) CT signs of active inflammatory disease vs fibrostenosing or mixed. 3) Proposed Crohns disease report terminology. 4) Discuss what the gastroenterologist wants to know.

ABSTRACT

CT enterography can provide a comprehensive evaluation of the small bowel in patients with Crohns disease. This presentation will discuss technical tips for optimizing bowel distention and reducing radiation dose.
findings of Crohn’s disease, differentiating active inflammatory vs fibrostenosing disease and the proposed terminology for describing these findings will also be demonstrated and discussed. Important findings to detect and describe for gastroenterologists will be demonstrated.

**VSGI31-02**

**Grading of Crohn’s Disease Activity Using CT, MRI, US and Scintigraphy: A Meta-analysis**

**Carl Alejandro Julien Puyaert MSc (Presenter): Nothing to Disclose, Jeroen Tielbeek MD: Nothing to Disclose, Shandra Bipat MS: Nothing to Disclose, Jaap Stoker MD, PhD: Research Consultant, Robarts Clinical Trials**

**PURPOSE**

To assess the role of computed tomography (CT), magnetic resonance imaging (MRI), ultrasonography (US) and scintigraphy in grading Crohn’s disease activity, with the primary endpoint of the proportional agreement between two MRE methods in diagnosing active bowel inflammation, with the noninferiority margin of 85% of agreement. Secondary analyses were performed about the agreement in interpreting penetrating diseases and regarding the MRE accuracy in the terminal ileum for diagnosing all severities of inflammation and for deep ulcers using the endoscopic findings as the reference test. Two independent reviewers assessed the data. Three by three tables (none, mild, frank disease) were constructed for all studies and overall grading accuracy, overgrading and undergrading were calculated/summarized by fixed or random effects models.

**RESULTS**

Our search yielded 9356 articles, from which 19 articles were determined eligible for inclusion. A total of 549 patients were included. Per-patient data showed overall grading accuracy values for CT, MRI, US and scintigraphy of 86% (95%CI: 75-93%), 84% (95%CI: 67-93%), 44% (95%CI: 28-61%) and 40% (95%CI: 16-70%), respectively. CT and MRI data were pooled and showed similar overall grading accuracy estimates (P=0.8). CT and MRI showed similar overgrading (P=0.5). Per-segment data showed overall grading accuracy values for CT, MRI, US and scintigraphy of 87% (95%CI: 77-93%), 78% (95%CI: 72-82%), 66% (95%CI: 52-78%) and 86% (95%CI: 80-91%), respectively. CT showed similar grading accuracy to MRI (P=0.08), while comparisons between CT and MRI and between CT and scintigraphy showed similar grading accuracy than US (P=0.001 and P=0.003, respectively). Similar overgrading was seen between CT and MRI (P=0.7), CT and scintigraphy (P=0.2), MRI and scintigraphy (P=0.09). MRI undergraded more than scintigraphy (P=0.004), while comparisons between CT and MRI and between CT and scintigraphy showed similar undergrading (P=0.1 and P=0.5, respectively).

**CONCLUSION**

CT and MRI showed similar high accuracy values and similar over-and undergrading both in the per-patient and per-segment analyses. Results for US and scintigraphy were inconsistent and limited data was available.

**CLINICAL RELEVANCE/APPLICATION**

Both CT and MRI can be used for grading of Crohn’s disease activity, with MRI being preferable as it lacks ionizing radiation exposure.

**VSGI31-03**

**MR Enterography with Diffusion-weighted Imaging to Substitute Intravenous Contrast for Evaluating Crohn’s Disease: A Noninferiority Study**

**Nieun Seo MD (Presenter): Nothing to Disclose, Seong Ho Park MD: Research Grant, DONGKOOK Pharmaceutical Co, Ltd Research Grant, General Electric Company, Kyung Jo Kim: Nothing to Disclose, Yedaun Lee MD: Nothing to Disclose, Bo-Kyeong Kang MD: Nothing to Disclose, Hyun Kwon Ha MD: Nothing to Disclose**

**PURPOSE**

To prospectively determine whether MR enterography (MRE) performed with diffusion-weighted imaging (DWI) and without intravenous contrast is diagnostically noninferior to conventional contrast-enhanced (CE) MRE for evaluating Crohn’s disease (CD).

**METHOD AND MATERIALS**

Fifty adults suspicious of CD prospectively underwent clinical assessment, MRE, and ileocolonoscopy within 1 week and 44 patients finally diagnosed with CD (M:F: 34:10; 26.9±6.1 years) were analyzed. Conventional CE-MRE and DWI at b=900 s/mm² were performed. Unenhanced DWI-MRE (i.e. T2-weighted sequences + DWI) and CE-MRE (i.e. T2-weighted sequences + dynamic CE T1-weighted sequences) were reviewed in separate sessions with proper blinding, a washout period, and randomization. A total of 172 small bowel segments representing the entire spectrum from normalcy to severe inflammation in CD as seen on CE-MRE were chosen for the review. The primary endpoint was the proportional agreement between two MRE methods in diagnosing active bowel inflammation, with the noninferiority margin of 85% of agreement. Secondary analyses were performed about the agreement in interpreting penetrating diseases and regarding the MRE accuracy in the terminal ileum for diagnosing all severities of inflammation and for deep ulcers using the endoscopic findings as the reference standard.

**RESULTS**

The agreement between unenhanced DWI-MRE and CE-MRE in interpreting active bowel inflammation was 92.4% (159/172; one-sided 95% CI, >88.4%). Therefore, the noninferiority of DWI-MRE to CE-MRE was established. Of 8 segments with penetrating diseases shown on CE-MRE, DWI-MRE interpreted 6 segments concordantly, characterized 1 abscess discordantly as phlegmon, and neglected 1 sinus tract. In the 41 terminal ilea with endoscopic reference standard, unenhanced DWI-MRE and CE-MRE did not reveal significant differences in the sensitivity for diagnosing all severities of inflammation (94% [32/34] vs. 97% [33/34]; P=1) or for diagnosing deep ulcers (95% [20/21] for both; P=1).
CONCLUSION

DWI-MRE was noninferior to CE-MRE in diagnosing bowel inflammation but showed more considerable discordance with CE-MRE in diagnosing penetrating diseases.

CLINICAL RELEVANCE/APPLICATION

DWI-MRE may substitute CE-MRE for evaluating bowel inflammation in CD patients who are contraindicated for the use of intravenous contrast and are not suspicious of having penetrating diseases.

VSGI31-04  Small Bowel Imaging in Occult GI Bleed

David J. Grand  MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role of CT for occult GI bleeding. 2) Understand and implement specific CT protocol optimized to detect source of occult GI bleed. 3) Detect and diagnose the various causes of occult GI bleed.

VSGI31-05  In the Work-up of Patients with Obscure Gastrointestinal Bleed, Does 64-slice MDCT Angiography Have a Role?

Chinmay Bhimaji Kulkarni  MBBS, MD (Presenter):  Nothing to Disclose, Srikanth Moorthy  MD : Nothing to Disclose, Sreekumar K P  MBBS, MD : Nothing to Disclose, Rajesh Ramaiah Kannan  MD : Nothing to Disclose

PURPOSE

To prospectively determine the sensitivity of 64-slice MDCT angiography in detecting and diagnosing the cause of obscure gastrointestinal bleed (OGIB).

METHOD AND MATERIALS

The study included 132 patients (male 93, female 39) in the age range of 3 -87 years (average age 55.13 years) who were referred to radiology department as part of workup for clinically evident gastrointestinal bleed or as part of workup for anemia (with and without positive fecal occult blood test) between 2007-2013. MDCT angiography was performed only after conventional upper endoscopy and colonoscopy were negative. Following a non-contrast scan, all patients underwent triple-phase contrast CT scan using a 64-slice CT scan system. The diagnostic performance of MDCT angiography was compared to the results of capsule endoscopy, 99m-technetium-labeled red blood cell scintigraphy (99mTc-RBC scintigraphy), digital subtraction angiography, and surgery whenever available.

RESULTS

CT scan showed positive findings in 80 of 132 patients. The sensitivity, specificity, positive predictive value, and negative predictive values of MDCT angiography for detection of bleed were 74.7%, 66.7%, 81.2%, and 57.7%, respectively. Capsule endoscopy was performed in 36 patients and was positive in 21 patients (sensitivity 78.2%). 99mTc-RBC scintigraphy was performed in 16 patients and was positive in 10 patients (sensitivity 71.4%). Digital subtraction angiography was performed in 34 patients and was positive in 28 patients (sensitivity 90.3%).

CONCLUSION

MDCT angiography is a sensitive and noninvasive tool that allows rapid detection and localization of OGIB. It can be used as the first-line investigation in patients with negative endoscopy and colonoscopy studies. MDCT and capsule endoscopy have complementary roles in the evaluation of OGIB.

CLINICAL RELEVANCE/APPLICATION

MDCT angiography is a sensitive and noninvasive tool that allows rapid detection and localization of obscure gastrointestinal bleed and can be used as the first-line investigation in patients with negative endoscopic studies.

VSGI31-06  MR of Fistula-in-ano

Tracy Anne Jaffe  MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

1) To review the MRI techniques for evaluating fistula-en-ano. 2) To review the MR findings of fistula-en-ano.

VSGI31-07  MR of Rectal Cancer

Mukesh Gobind Harisinghani  MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the role of MR in accurate staging of rectal cancer. 2) Review MR technique, anatomy pertinent to rectal cancer staging.

**ABSTRACT**

The presentation will provide a comprehensive overview of the role of MR in staging rectal cancer

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**VSGI31-08**

**Patient Selection for Local Excision: Preoperative MRI to Predict Negative Lymph Node Metastasis in Patients with Clinical T1 and T2 Stage Rectal Cancer**

Beomseok Sohn MD (Presenter): Nothing to Disclose, Chansik An MD: Nothing to Disclose, Joonseok Lim MD: Nothing to Disclose, Muyeong-Jin Kim MD, PhD: Nothing to Disclose

**PURPOSE**

To minimize the false-negative rate (FNR) of preoperative MRI in the diagnosis of lymph node (LN) metastasis in patients with clinical T1 or T2 rectal cancer. Local excision can reduce the morbidities from radical surgery, but has shown high local recurrence rates due mainly to undetected LN metastasis. Ideally, minimized FNR for detecting LN metastasis would maximize the identification of patients suitable for local excision.

**METHOD AND MATERIALS**

A total of 246 patients with clinical T1/T2 rectal cancer who underwent MRI within one month before surgery were included in this study. The tumor location, morphology, tumor diameter/volume, and depth of tumor invasion were evaluated using MRI. Patients were categorized into three groups according to the LN size and morphology: Group 1, no discernible regional LN or all visible LNs <3 mm; Group 2, not belonging to either Group 1 or 3; and Group 3, at least one LN >5 mm showing irregular margins or internal heterogeneity.

**RESULTS**

Lower LN group and partial tumor invasion of the muscular layer were significantly associated with lower risks of LN metastasis. When it was considered negative for LN metastasis if the patient belonged to LN Group 1 or 2 regardless of the depth of tumor invasion, the FNR were 13.6%. When only LN Group 1 was considered negative for LN metastasis, the FNR was still 9.7%. Addition of invasion depth to the diagnostic criteria decreased the FNR from 13.6% to 5.8% (LN Group 1/2 with partial tumor invasion) and from 9.7% to 3.2% (LN Group 1 with partial tumor invasion).

**CONCLUSION**

Inclusion of tumor invasion depth in LN evaluation using preoperative MRI can reduce the FNR for LN metastasis in patients with clinical T1 or T2 rectal cancer.

**CLINICAL RELEVANCE/APPLICATION**

We can better identify a low risk group for regional LN metastasis among patients with early-stage rectal cancer by assessing the depth of tumor invasion and regional LNs using preoperative MRI. Application of these criteria may help minimize the likelihood of offering local excision to a patient who might have LN metastasis.

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**VSGI31-09**

**Combined Predictive Value of Functional Imaging Markers Derived from Correlations of PET/CT and Diffusion Weighted MRI in Response Assessment of Rectal Cancer Treatment after Neoadjuvant Radiochemotherapy**

Davide Ippolito MD (Presenter): Nothing to Disclose, Pietro Andrea Bonaffini MD: Nothing to Disclose, Davide Fior MD: Nothing to Disclose, Silvia Girolama Drago: Nothing to Disclose, Giulia Querques MD: Nothing to Disclose, Sandro Sironi MD: Nothing to Disclose

**PURPOSE**

To assess the clinical diagnostic value of functional imaging, combining quantitative parameters of ADC and SUV max, before and after chemo-radiation therapy, in prediction of tumor response of patients with rectal cancer, related to tumor regression grade at histology.

**METHOD AND MATERIALS**

A total of 51 patients with biopsy proven diagnosis of rectal carcinoma were enrolled in our study. All patients underwent a whole body 18 FDG PET/CT scan and a pelvic MR examination including DW imaging for staging (PET 1, RM1) and after completion (6.6 weeks) of neoadjuvant chemoradiation treatment (PET 2, RM 2). Subsequently all patients underwent total mesorectal excision and the histological results were compared with imaging findings. The MR scanning, performed on 1.5 T magnet (Philips,Achieva), included T2-weighted multiplanar imaging and in addition DW images with b-value of 0 and 1000 mm²/sec. On PET/CT the SUV max of the rectal lesion were calculated in PET1 and PET2. The percentage decrease of SUVmax(ΔSUV) and ADC (ΔADC) values from baseline to presurgical scan were assessed and correlated with pathologic response classified as tumor regression grade (Mandard’s criteria; TRG 1= complete regression, TRG 5= no regression).

**RESULTS**

At histology, according to Mandard’s criteria, 33 cases (65%) showed complete or subtotal response (TRG 2-3)
At histology, according to Mandard’s criteria, 33 tumors (68%) showed complete or subtotal regression (TRG1-2) and were classified as responders; 18 tumors (32%) were classified as non-responders (TRG3-5). Considering all patients, the mean values of SUVmax in PET 1 was higher than mean value of SUVmax in PET2 (p<0.001), whereas mean ADC values was lower in MR 1 than MR2 (p<0.001). The best predictors for TRG response were SUV2 (threshold of 4.4) and ADC2 (1.28x10^-3 mm^2/s); combining in a single analysis median quantitative value, the PPV in predicting different group category response, related to TRG system, presented an overall AUC of 96%, higher than DWI (88.2%) or SUVmax (93.3%).

**CONCLUSION**

In era of PET/MRI the combination of functional data derived from DWI and PET/CT represents the most accurate method to evaluate the response to treatment in LARC patients, with repeatable accuracy values higher than those reported for other conventional imaging techniques.

**CLINICAL RELEVANCE/APPLICATION**

The functional imaging combining ADC and SUVmax permits to detect changes in cellular tissue structures useful for the assessment of tumour response after the neoadjuvant therapy in rectal cancer patients.

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**VSGI31-10**

**CT Colonography and Colorectal Cancer Screening**

Perry J. Pickhardt MD (Presenter): Co-founder, VirtuoCTC, LLC Stockholder, Cellectar Biosciences, Inc

**LEARNING OBJECTIVES**

1) Understand the recent developments in CTC screening, including guideline updates and coverage determinations. 2) Appreciate the potential added value of extracolonic data for wellness and screening. 3) Become aware of emerging data with regard to other competing CRC screening tools.

**ABSTRACT**

The presentation will provide an update on the current status of guidelines and coverage issues for CTC screening. Recent clinical data for CTC will be reviewed, including the potential value-added assessment from extracolonic findings.

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**VSGI31-11**

**Missed Colorectal Polyps at Optical Colonoscopy Despite Prospectively Known Positive CT Colonography Findings**


**PURPOSE**

The diagnostic performance of optical colonoscopy (OC) for colorectal polyp detection has been estimated in previous CT colonography (CTC) trials using segmental unblinding of CTC findings. However, these estimates do not account for lesions missed by OC after unblinding, which have been unavoidably labeled as CTC false positives. Our purpose was to determine how many discordant lesions in our clinical practice actually prove to be OC false negatives on subsequent examination.

**METHOD AND MATERIALS**

During a 113 month period, 9,336 patients (mean age 57.1±8.0 years, M:F 4,210:5,126) underwent CTC at a single center, yielding 2,606 non-diminutive polyps. Of 1,731/2,606 polyps that underwent follow-up OC, 1,550 (90%) were concordant and 181 (10%) were discordant. CTC results (size, location, morphology) were revealed to colonoscopists prior to OC. After independent consensus review by at least two radiologists, 115 discordant findings were felt to be possible OC false negatives, and were further evaluated at repeat CTC and/or OC.

**RESULTS**

Of the 115 possible OC false negatives, 37 were either lost to follow-up or still awaiting follow-up at the time of study. Of the remaining 78 polyps 31 (40%) were confirmed to be OC false negatives at follow-up evaluation (26 by OC, 5 by CTC), and 47 (60%) were again not found, and remain CTC false positives. Compared with CTC false positives, OC false negatives were more likely to be larger (10.6 ± 5.3 mm vs 8.5 ± 3.3 mm, p=0.034) and to have higher diagnostic reader confidence at initial CTC (mean 2.8/3 vs 2.3/3, p=0.001). OC false negatives were more likely than OC/CTC concordant polyps to be located in the right colon (71% vs 47%, p=0.010). Of OC false negatives confirmed at subsequent OC, 17/26 (65%) had adenomatous histology (1 tubulovillous adenoma, 11 tubular adenoma, 5 serrated adenoma), of which 6 were advanced lesions.

**CONCLUSION**

Among discordant polyps at OC following positive CTC, OC false negatives are a common occurrence even when CTC findings are known prior to colonoscopy. Proven OC false negatives were ≥10 mm on average, more likely to be located in the right colon, and called with higher diagnostic confidence on CTC. Most ultimately resected OC false negatives proved to be adenomatous histology, including a substantial fraction of advanced lesions.

**CLINICAL RELEVANCE/APPLICATION**

An understanding of missed polyps at colon cancer screening is vital to improving detection and patient care.
Interventional Series: Complications in Interventional Oncology - Avoidance, Recognition and Management

Series Courses

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.75
Tue, Dec 2 8:30 AM - 12:00 PM   Location: E353A

Participants
Moderator
Charles E. Ray MD, PhD : Nothing to Disclose

LEARNING OBJECTIVES

1) List 2 important recent publications in interventional oncology. 2) Explain the mechanism of one complication related to thermal ablation. 3) Describe 1 pitfall of radioembolization. 4) Outline 3 complications in combination therapy for hepatocellular carcinoma. 5) List three complications of chemo-embolization. 6) Describe rationale for and against training programs in interventional oncology.

Sub-Events

VSIR31-01  Chemo-Embolization Cxs
Charles E. Ray MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIR31-02  Effect of Intra-Arterial Therapies to Treat Liver Cancer on Portal Hypertension: Non-Invasive Assessment of Surrogate Markers of Portal Venous Pressure

Rafael Duran MD, Julius Chapiro MD, Ahmet Bas MD, MingDe Lin PhD : Employee, Koninklijke Philips NV, Ruediger Egbert Schernthaner MD, Jae Ho Sohn MS (Presenter): Nothing to Disclose, Gayane Yenokyan PhD : Nothing to Disclose, Jean-Francois H. Geschwind MD : Consultant, BTG International Ltd Consultant, Bayer AG Consultant, Guerbet SA Consultant, Nordion, Inc Grant, BTG International Ltd Grant, F. Hoffmann-La Roche Ltd Grant, Bayer AG Grant, Koninklijke Philips NV Grant, Nordion, Inc Grant, ContextVision AB Grant, CeloNova BioSciences, Inc Founder, Prescience Labs, LLC CEO, Prescience Labs, LLC

PURPOSE

Theoretically intra-arterial therapies (IATs) are mainly targeting tumor tissue. However, part of the payload is inevitably delivered to non-tumoral liver tissue, thus potentially causing damage over time which in return may influence the portal venous pressure (PVP). The aim of this study was to investigate potential effects of IATs on PVP using non-invasive surrogate markers of portal hypertension.

METHOD AND MATERIALS

This retrospective analysis included 107 patients (57 in hepatocellular carcinoma (HCC) group and 50 in metastatic group) who underwent IATs and had longitudinal pre-/post- therapy contrast-enhanced (ce)MRI as well as blood work follow-up. Porto-systemic shunts, ascites, and vascular invasion were evaluated on MRI. In addition, splenic volumes were measured on portal-venous-phase ceMRI. Platelet count (PC; in 10^9/L) and liver function were evaluated. Generalized linear mixed effects models with random intercept for patient and random slope for time trajectory were used to assess associations between IAT and the outcomes adjusting for potential confounders and accounting for the longitudinal nature of the data.

RESULTS

A total of 291 IAT procedures (230 cTACE, 47 DEB-TACE and 14 Y90 radioembolization) were performed. Spleen volume showed a linear increase with additional IAT sessions by on average of 17cm^3/session (95%CI:7-27, p< .0001) after controlling for IAT method, diagnosis, spleen volume and ascites status at baseline. Patients treated with cTACE or DEB-TACE showed an association with a higher PC as compared to Y90 radioembolization, with values of 51 (P=.02) and 75 (p=.005) units above radioembolization, respectively. There was no statistically significant difference in PC between cTACE and DEB-TACE. PC showed a decrease with each additional IAT session by 12 units (95%CI:3-20, p=.008) after controlling for IAT method, diagnosis and PC at baseline.

CONCLUSION

Preliminary results indicate that those IATs with larger embolic effects (cTACE/DEB-TACE) lead to a larger increase of PVP and higher PC over time as compared to procedures with less embolic effect (Y90).
increase of PVP and higher PC over time as compared to procedures with less embolic effect (Y90).

**CLINICAL RELEVANCE/APPLICATION**

IATs seemed to increase PVP over time however with low complications-rate related to increased portal hypertension.

**VSIR31-03**

**Safety of Radioembolization with 90Yttrium-microspheres Depending on Coiling or No-coiling of Aberrant/High-risk Vessels**

Philipp Marius Paprottka (Presenter): Nothing to Disclose, Karolin Johanna Kutter: Nothing to Disclose, Alexander Haug MD: Nothing to Disclose, Christoph Gregor Trumm MD: Nothing to Disclose, Tobias Franz Jakobs MD: Speaker, Sirtex Medical Ltd Research Consultant, Sirtex Medical Ltd Speaker, Siemens AG Speaker, Terumo Corporation Speaker, Surefire Medical, Inc, Maximilian F. Reiser MD: Nothing to Disclose, Christoph Johannes Zech MD: Research Grant, Bayer AG Speaker, Bayer AG Travel support, Bayer AG Advisory Board, Bayer AG Speaker, Bracco Group Travel support, Bracco Group

**PURPOSE**

To evaluate the safety of radioembolization with 90Yttrium-microspheres depending on coiling or no-coiling of aberrant/high-risk vessels.

**METHOD AND MATERIALS**

The early and late toxicities of 566 radioembolization procedures were retrospectively analyzed according to the National Cancer Institute's Common Terminology Criteria for Adverse Events (CTCAE v3.0). In 240 procedures the aberrant vessels were coiled prior to radioembolization and in 326 procedures we chose a more peripheral position to treat the right or left liver lobe.

**RESULTS**

According to the CTCAE criteria clinical relevant late toxicities (≥ Grade 3) could only be observed in 1% of our patients. Furthermore our statistical analysis showed significant less "any" (p=0.0001) and "clinical relevant" (p=0.0003) early complications for no-coiling. There was no significant difference (p > 0.05) in delayed toxicities depending on actually recommended coiling of aberrant/high-risk vessels prior to treatment in comparison to choosing a peripheral treatment position. No radiation induced liver disease was noted in 566 procedures.

**CONCLUSION**

Radioembolization with 90Yttrium-microspheres is a safe and effective treatment option. Performing of radioembolization without coiling aberrant vessels prior to treatment could be an alternative option for experienced centers.

**CLINICAL RELEVANCE/APPLICATION**

Our findings could lead to a change of the pre-interventional radioembolization work-up.

**VSIR31-04**

**Evaluation for Radioembolization in HCC: CT Predictors for High Hepatopulmonary Shunt Fractions and Changes Following Sorafenib Therapy**


**PURPOSE**

A high hepatopulmonary shunt (HPS) fraction might represent a contraindication for Yttrium 90 radioembolization (RE) in patients with unresectable hepatocellular carcinoma (HCC). The protein kinase inhibitor sorafenib has been shown to possibly reduce the HPS in selected cases. Our aim was to assess if CT predictors for a high HPS exist and if these show changes after sorafenib therapy.

**METHOD AND MATERIALS**

CT images of 70 HCC patients (mean age 69.8y; 60m, 10w) scheduled for MAA scan were retrospectively evaluated by two radiologists in consensus. Two groups of patients matched for age and gender were evaluated: (a) increased HPS (>15%, n=35), (b) low HPS (<5%, n=35). Tri-phasic CTs prior to the DSA were analyzed regarding signs of early venous enhancement, venous tumor infiltration, portal vein thrombosis, and portosystemic shunts. Conspicuities were correlated with HPS values and where applicable effects of sorafenib on these were recorded before repeated MAA scan.

**RESULTS**

In 16/35 patients with high HPS, early (arterial) enhancement of intrahepatic veins and/or tumor infiltration of liver veins could be appreciated; 9 more patients showed compressed/shifted liver veins. Very high HPS (>20%) was associated with early venous enhancement (n=9) more frequently than high HPS (15-20%; n=2). Patients with low HPS did not show these signs. Portal vein thrombosis occurred more often with high HPS (n=21) compared to low HPS (n=9). All other aspects occurred in both groups independent of HPS. Eight patients with high HPS received sorafenib in the aftermath, reducing early (arterial) enhancement of liver veins and/or enhancement of tumor parts infiltrating liver veins in 8/8 cases; additionally a reduction of the HPS in 7/8 cases allowed for Yttrium 90 therapy.
CONCLUSION

High hepatopulmonary shunts are associated with CT predictors which may be alleviated after sorafenib therapy in selected cases. Early (arterial) enhancement of liver veins is strongly related to very high hepatopulmonary shunts.

CLINICAL RELEVANCE/APPLICATION

Patients with increased risk for a high hepatopulmonary shunt might be identified in CT and could be pre-treated with sorafenib prior to the first MAA scan to prevent repetitive angiographies.

Comparative Study Evaluating Pain after Hepatectomy, Percutaneous Radiofrequency and Percutaneous Microwave Ablation in Patients with HCC or Metastatic Hepatic Lesions

Georgios Velonakis MD (Presenter): Nothing to Disclose, Dimitrios Filippiadis MD, PhD: Nothing to Disclose, Maria Alkiviades Mademli MD: Nothing to Disclose, Katerina Malagari: Nothing to Disclose, Alexios Kelekis MD, PhD: Consultant, Benvenue Medical, Inc, Nikolaos L. Kelekis MD: Nothing to Disclose

PURPOSE

To evaluate and compare post treatment pain in patients with HCC or metastatic liver lesions treated with surgery, percutaneous radiofrequency, or percutaneous microwave ablation.

METHOD AND MATERIALS

During 2 years, 103 patients treated for HCC or metastatic liver lesions were divided in three groups. 37 patients (Group A) underwent surgical operation (partial hepatectomy), 32 patients (Group B) underwent Computed Tomography (CT)-guided radiofrequency ablation (Leveen needle Radiofrequency electrode 5.0) and 34 patients (Group C) underwent CT-guided microwave ablation (16G Microwave probe). In Groups B and C ablation was performed under conscious sedation. Numeric Visual Scale questionnaire for pain was used to evaluate pain daily during follow-up. The required analgesics (type and dose) for all patients were recorded.

RESULTS

Mean pain duration post treatment was 10.76±2.80 days in Group A, 1.34±0.75 in Group B and 1.41±0.74 in Group C. Differences in mean pain duration between surgery and radiofrequency and between surgery and microwave ablation were 9.41 and 9.35 days respectively. These differences were statistically significant (p<0.001). There was no statistically significant difference in pain duration between Groups B and C. Mean pain score in Group A was 7.68±0.884 NVS units in day 1, 7.43±0.929 in day 2, 6.97±1.118 in day 3 and 6.35±1.086 NVS units in day 4. The respective pain scores in Group B were 1.66±1.894 in day 1, 0.66±0.865 in day 2, 0.03±0.177 in day 3 and 0 in day 4. In Group C mean pain scores were 1.97±1.838 NVS units in Day 1, 0.62±0.187 in Day 2, 0.03±0.172 in day 3 and 0 in day 4. Differences in mean pain scores were statistically significant between surgery and percutaneous treatment for each of the 4 first days (p<0.001), but there was no statistically significant difference between radiofrequency and microwave ablation. No clinically significant complications were noticed.

CONCLUSION

Pain is an important complication post hepatic resection. Both image-guided percutaneous microwave ablation and radiofrequency ablation seem to be correlated with clinically insignificant pain post treatment as opposed to hepatectomy.

CLINICAL RELEVANCE/APPLICATION

Image guided percutaneous microwave ablation and radiofrequency ablation of HCC or metastatic liver lesions are correlated with minimal pain, and they can be easily tolerated even if repeated sessions are required.

Y-90 Cxs

Robert J. Lewandowski MD (Presenter): Advisory Board, Nordion, Inc Advisory Board, BTG International Ltd Advisory Board, Boston Scientific Corporation Consultant, Cook Group Incorporated

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

Discern the clinical variables that make a patient a good candidate for radioembolization Recognize common vascular anatomic variants predisposing to non-target delivery of yttrium-90 microspheres Understand the concept of radiation-induced liver disease and factors predisposing to it

Debate: There Should be Dedicated Training Programs Devoted to IO Only

Daniel B. Brown MD (Presenter): Consultant, Cook Group Incorporated Consultant, Medtronic, Inc, Charles E. Ray MD, PhD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

Interventional Oncology is the most rapidly growing area of Interventional Radiology. Achieving a satisfactory fund of knowledge of oncologic patient management as well as mastering procedural and clinical skills requires training beyond that available in traditional fellowships. Interventional Oncology is the first IR subspecialty

**VSIR31-08**

**Thermal Ablation Cxs**

Daniel B. Brown MD (Presenter): Consultant, Cook Group Incorporated Consultant, Medtronic, Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

Complications are unusual with thermal ablation but can be severe. This presentation is designed to avoid complications as well as identify untoward events early after therapy to optimize management. Techniques to manage complications will be reviewed.

**VSIR31-09**

**Combination Therapy Cxs**

Thuong Gustav Van Ha MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

Combination therapy utilizing both transarterial chemoembolization and thermal ablation will be discussed with an emphasis on complications. Different techniques of TACE will be shown, in combination with either radiofrequency ablation or microwave ablation. Management of complications will also be discussed.

**VSIR31-10**

**Evaluation of an Experimental Thermoprotective Gel for Hydrodissection during Percutaneous Microwave Ablation: In Vivo Results**


PURPOSE

Hydrodissection is an important technique to protect non-target structures during thermal ablation, but is hampered by the mobility of injected fluid. This study evaluated whether a thermoreversible poloxamer P407 (liquid at room temperature, gel at body temperature) can protect the diaphragm, body wall, and bowel adjacent to large microwave (MW) ablation zones in a porcine model.

METHOD AND MATERIALS

P407 was prepared in a 15.4% solution with 2% iohexol. Antennas were placed percutaneously into extremely superficial liver, spleen, or kidney (target tissues) under US and CT guidance in 5 pigs under general anesthesia such that the expected ablation zones would extend into adjacent diaphragm, body wall, or bowel (non-target tissues). For experimental ablations, P407 was injected into the potential space between target and non-target tissues, and presence of a gel barrier was verified on CT. No barrier was used for controls. MW ablation was performed using a single antenna at 65W for 5 minutes. Gross dissection was performed after sacrifice to inspect tissues for thermal damage, which was verified using a histologic viability stain.

RESULTS

Antennas were placed 7 ± 3 mm from the organ surface for both control and gel-protected ablations (p<0.05). The volume of gel deployed was 49 ± 27 mL, resulting in a barrier with a thickness of 0.75 ± 0.48 cm. Ablations extended into non-target tissues in 12/14 control ablations with a mean non-target tissue burn of 3.8 cm2, but only 4/14 gel-protected ablations with a mean non-target tissue burn of 0.2 cm2 (p<0.05). The gel stayed at the injection site throughout power delivery, with interval resorption of gel and accumulation of contrast in the bladder by 2.5h post-procedure.

CONCLUSION
In this extreme scenario, P407 demonstrates viability as a tool for percutaneous tissue hydrodissection, as well as efficacy in protection of non-target structures during microwave ablation.

**CLINICAL RELEVANCE/APPLICATION**

As a thermoreversible poloxamer being explored for many novel medical applications, P407 exhibits potential utility in percutaneous tissue hydrodissection, effectiveness in thermoprotection during microwave ablation, and ability for maintenance at the injection site for the duration of power application. Further comparison of P407 to existing hydrodissection fluids and continued investigations into pharmacologic properties appear warranted.

**VSIR31-11**

**Percutaneous Ultrasound Guided Irreversible Electroporation in Locally Advanced Pancreatic Cancer: Short Term Complications**

Anders K. Nilsson MD, PhD (Presenter): Nothing to Disclose, Christoffer Mansson MD: Nothing to Disclose, Brittmarie Karlson MD, PhD: Nothing to Disclose

**PURPOSE**

To determine if irreversible electroporation (IRE) can be used in patients with locally advanced pancreatic cancer without too many serious adverse effects.

**METHOD AND MATERIALS**

Between October 2011 and January 2014, 42 patients with locally advanced pancreatic cancer were treated with IRE, the primary goal being a locally complete ablation. All patients were discussed at a multidisciplinary conference and were determined to be unsuitable for surgery due to extensive vessel involvement and/or liver metastases. 3-6 IRE needles were placed in and around the tumour with distances not exceeding 20 mm. Active needle length was 15 mm. Ablations were performed until 90 pulses had been delivered between each relevant needle pair with a current of at least 30A. The aim was to create an ablation zone with a diameter of 4-5 cm. Clinical, laboratory and imaging data were recorded to detect complications.

**RESULTS**

Out of the 42 included patients, 27 no serious adverse effects. More serious complications occur in 15 patients (33%) and included duodenal perforation (1), bile duct perforation (1), bleeding (2), portal vein thrombosis (2) and pain requiring more than basic pain relief and diarrhea (8). 1 patient developed jaundice after the procedure and died during the subsequent ERCP.

**CONCLUSION**

Ultrasound guided percutaneous IRE ablations can be used in an attempt to achieve local tumour control in patients with locally advanced pancreatic cancer. The procedure offers a reasonable alternative when surgery is not possible but has a significant complication rate. The complications seem to be due to both the needle placement and the actual ablation.

**CLINICAL RELEVANCE/APPLICATION**

IRE ablation in the region of the pancreatic head is possible without damage to vessels and other vulnerable structures and can therefore be attempted when surgery is not possible. Furthermore, as ablations in this area will affect arteries and veins as well as nerves, bile ducts, bowel walls and pancreatic tissue, it can be seen as an indication that IRE can be used in other areas inaccessible to thermal ablations.

**VSIR31-13**

**Literature Review: The Most Important IO Papers from 2013-2014**

Charles E. Ray MD, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**VSMK31**

**Musculoskeletal Series: Ultrasound**

**Series Courses**

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

Tue, Dec 2 8:30 AM - 12:00 PM Location: E450A

**Participants**

Moderator
LEARNING OBJECTIVES

The 'Ultrasound' Series Course will review musculoskeletal sonography through live instruction by expert refresher course instructors, interspersed with scientific presentations.

Sub-Events

**VSMK31-01**  
**Shoulder Ultrasound (Demonstration)**

Jon A. Jacobson MD (Presenter): Consultant, BioClinica, Inc  
Royalties, Reed Elsevier  
Equipment support, Terumo Corporation  
Equipment support, Arthrex, Inc

**LEARNING OBJECTIVES**

1) Be familiar with ultrasound examination and anatomy of the shoulder and common pathology.

**ABSTRACT**

The goal of this live demonstration is to review shoulder ultrasound technique, which will be completed in 5 steps. The first step evaluates the long head of the biceps brachii tendon in short and long axis with the shoulder in neutral position. Step #2 with external rotation of the humerus evaluates the subscapularis in long and short axis, as well as the biceps brachii tendon for subluxation or dislocation. Step #3 evaluates the supraspinatus in long and short axis, as well as the distal infraspinatus tendon. Understanding the greater tuberosity facets is helpful in distinguishing between the supraspinatus and infraspinatus. Step #4 evaluates the acromioclavicular joint. With humerus abduction, the shoulder is also evaluated for subacromial impingement. Step #5 with the shoulder in neutral position evaluates the posterior glenohumeral joint recess, the posterior labrum, the spinoglenoid notch, and the infraspinatus muscle for fatty degeneration and atrophy. A comprehensive evaluation is essential to accurately diagnose shoulder pathology.

**VSMK31-02**  
**Sonographic Median Nerve Cross Sectional Area Measurement in CTS Patients: Can Delta and Ratio Calculations Predict Severity Compared to Nerve Conduction Studies?**

Mohamed Mahmoud Hamdy Abd Ellah MD (Presenter): Nothing to Disclose  
Thomas Auer MD: Nothing to Disclose  
Eberle Gernot MD: Nothing to Disclose  
Lenka Gerencerova MD: Nothing to Disclose  
Sylvia Strobl MD: Nothing to Disclose  
Christian Kremser PhD: Nothing to Disclose  
Gudrun Feuchtner MD: Nothing to Disclose  
Fabian Plank MD: Nothing to Disclose  
Mihra S. Taljanovic MD: Nothing to Disclose  
Werner R. Jaschke MD, PhD: Nothing to Disclose  
Andrea Klauser MD: Nothing to Disclose

**PURPOSE**

To evaluate the role of high resolution US in prediction of carpal tunnel syndrome (CTS) severity compared to nerve conduction studies.

**METHOD AND MATERIALS**

643 wrists of 427 CTS patients (325 females and 102 males), age ranged between 17-90 years (57.9+-14.7, mean+/-Std) were included in this study. CTS was diagnosed clinically and confirmed by nerve conduction studies (NCS). US was performed using a 14-8-MHz (LA424, 14-8 MPX; Esaote, Genoa-Firenze, Italy) or 18-6-MHz (LA435, MyLab90; Esaote) linear array transducer. CTS severity was classified according to NCS. Cross sectional measurements (CSA) of the median nerve was done at the level of the carpal tunnel (CSAc) and more proximally at the level of the pronator quadratus muscle (CSAp). Two parameters were calculated; Δ-CSA which is the difference between the proximal and distal measurements, and R-CSA which is the ratio calculated by dividing the distal over the proximal CSA.

**RESULTS**

Patients were classified into three groups (mild, moderate, and severe) according to severity by NCS. The mean CSA was (12.5, 14.7, and 18.8), mean Δ-CSA was (4.2, 6.95, and 10.7), and mean R-CSA was (1.5, 1.95, and 2.4) in all groups respectively with a significant difference between all groups (p<0.001). The cut off value was 5.5, and 8.5 between groups 1 and 2, and groups 3 and 4 respectively for Δ-CSA, while it was 1.7 and 2.2 between the same groups for R-CSA.

**CONCLUSION**

By implementing cut off values for the calculated parameters (Δ-CSA and R-CSA), high resolution US showed ability to predict CTS severity compared to NCS.

**CLINICAL RELEVANCE/APPLICATION**

1. The difference between cross-sectional areas of the median nerve measured at the level of the carpal tunnel (CSAc) and at the level of the pronator quadratus muscle (CSAp) - Δ-CSA - and the ratio between the two values - R-CSA - increases with the severity of Carpal tunnel syndrome (CTS). 2. Those parameters showed significant difference between different patient groups, which were classified according to nerve conduction study results (mild, moderate, and severe). 3. Better severity determination with Δ-CSA and R-CSA is obtained with better sensitivity and specificity values compared tp measured CSAc alone especially for the differentiation between mild and moderate groups. 4. Cut off values were obtained for each parameter (Δ-CSA and R-CSA) between the different CTS severity groups.
PURPOSE

To evaluate the diagnostic performance of ultrasound (US), magnetic resonance imaging (MRI), and magnetic resonance arthrography (MRA) in patients with recurrent rotator cuff tear after rotator cuff repair, using revision surgery as the standard of reference.

METHOD AND MATERIALS

Institutional review board approval was obtained and informed consent was waived. This retrospective study included 104 consecutive patients (111 shoulders, 63 men, 41 women; mean age, 54.5 years) with recurrent and/or persistent symptoms after rotator cuff repair and subsequent revision surgery from January, 2004 to November, 2013. Reports of US in 52 patients (54 shoulders), MRI in 63 patients (68 shoulders), MRA in 17 patients were reviewed with consensus to determine the presence or absence of recurrent full thickness rotator cuff tear. The imaging results were then compared with the operative reports.

RESULTS

Overall, sensitivity, specificity, accuracy, positive predictive value and negative predictive value in detection of recurrent rotator cuff full-thickness tear in postoperative shoulder were of 90.0%, 87.5%, 94.4%, 90.0% and 87.5% by US, respectively; 82.5%, 92.9%, 86.8%, 94.3% and 86.8% by MRI, respectively. MRA had 100% in all values. The differences in performance of MRI and US for detecting recurrent rotator cuff full-thickness were not statistically significant.

CONCLUSION

MRI, US and MRA in particular, are highly accurate means for assessing recurrent full thickness tears in postoperative shoulders.

CLINICAL RELEVANCE/APPLICATION

For detection of rotator cuff tear in shoulders that have not undergone surgery, ultrasound (US), magnetic resonance imaging (MRI), and magnetic resonance arthrography (MRA) are all accurate methods with high sensitivity and specificity. However, imaging assessment of rotator cuff in postoperative shoulders can be challenging.

VSMK31-04  Sonographic-guided Procedures (Demonstration)


Kathy Quenneville BS, RT (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To demonstrate optimal techniques for performing sonographic-guided procedures.

VSMK31-05  May Intratendinous US-guided Platelet Rich Plasma (PRP) Injection Modify the Natural History of Degenerative Tendinopathy of Rotator Cuff Tendons of the Shoulder? Results of 4 years of Clinical and MRI Follow-up

Francesco Arrigoni (Presenter): Nothing to Disclose, Lorenzo Maria Gregori: Nothing to Disclose, Alice La Marra MD: Nothing to Disclose, Luigi Zugaro: Nothing to Disclose, Antonio Barile MD: Nothing to Disclose, Carlo Masciocchi MD: Nothing to Disclose

PURPOSE

There is currently no literature describing the diagnostic imaging of the long-term outcomes in case of US-guided PRP injection of the supraspinatus tendon. The aim of this study was to evaluate the evolution of the degenerative tendinopathy of the rotator cuff from the morphological (MRI images) and clinical point of view 4 years after treatment with US-guided PRP injection of the supraspinatus tendon, compared with patients submitted to medical and physical therapy alone.

METHOD AND MATERIALS

We retrospectively evaluated 240 patients (all patients with history of trauma or surgery during the follow-up were excluded), 120 treated 4 years before with US-guided PRP injection of the supraspinatus tendon (group 1, G1) and 120 submitted, over a 4 year period, to medical and physical therapy alone (group 2, G2). For each patient, 2 radiologists independently evaluated the MRI performed before and 4 years after the injection (G1) or, in the G2, 2 MRIs performed at the distance of 4 years from each other, dividing the results into 3 categories for each group: improvement, stationary findings or worsening. A clinical and functional evaluation was also performed (VAS and Constant scale).

RESULTS
We recorded an improvement in the MRI appearance of the supraspinatus tendon in 31.7% of the G1 and only in 3.3% of G2; stationary findings were found in 48.3% in the G1 and in 34.2% in the G2, while worsening was of 20% in G1 and 62.5% in G2. Clinical evaluation: the mean VAS values showed improvement of 74.5% for the G1 and of 16.2% for G2; mean Constant values showed improvement of 56% (G1) and 9% (G2).

CONCLUSION

This study suggests that the US-guided PRP injection can be effectively used in the rotator cuff tendinopathy. Our results show the ability to regenerate and delay the degenerative processes: not only there is a higher percentage of patients with an improvement of the MRI appearance of the supraspinatus tendon 4 years after PRP injection, but also the number of patients that show a worsening of the MRI findings is lower in the G1 than in the G2. The clinical findings reflect positive outcomes in terms of pain relief and functional improvement.

CLINICAL RELEVANCE/APPLICATION

To evaluate, with a 4 year follow-up, clinical and functional effects and imaging findings of US-guided PRP injections of the supraspinatus tendon compared with natural history of tendinopathy.

VSMK31-06

Ultrasound-guided Perineural Injection of Upper Extremity and Sciatic Nerves: Does Single Needle Position Produce Circumferential Nerve Coverage?

Ogona Kenechi Nwawka MD (Presenter): Nothing to Disclose, Theodore T. Miller MD: Nothing to Disclose, Gregory Roy Saboeiro MD: Research funded, Terumo Corporation Speakers Bureau, Bioventus LLC, Shari Tamar Jawetz MD: Nothing to Disclose

PURPOSE

Our current clinical technique for ultrasound-guided perineural injection consists of placing the needle along both the superficial and deep surfaces of the nerve to obtain circumferential distribution of the injectate. This study aims to determine if a single needle position will produce circumferential coating of a nerve.

METHOD AND MATERIALS

For this IRB approved study, 6 upper extremity and 3 pelvic fresh cadaveric specimens were obtained. For the upper extremity, a 25 gauge hypodermic needle was positioned along the deep surface of the median nerve in the carpal tunnel, the radial nerve in the radial tunnel, and the ulnar nerve in the cubital tunnel, and 2 ml of dilute Omnipaque-300 contrast was injected for each nerve. In the pelvis, a 22 gauge spinal needle was positioned deep to the sciatic nerve, and 5 ml of contrast was injected. Thus, 18 upper extremity nerves (6 median, 6 radial, 6 ulnar) and 6 sciatic nerves were injected. All needle placements and injections were performed under ultrasound guidance by two experienced musculoskeletal radiologists. The specimens then underwent CT scanning, and the distribution of perineural contrast was assessed by a musculoskeletal radiologist not involved in the injections.

RESULTS

6/6 radial and 6/6 ulnar nerves demonstrated circumferential distribution of injectate on CT. Only 3/6 median nerves had circumferential coverage. 6/6 sciatic nerves demonstrated circumferential coverage on CT. The average length of spread for the upper extremity perineural injectate was 12.5 cm, with a range of 5.5 cm to 20 cm. For the sciatic nerves, the average length of spread was 10.3 cm, ranging from 6.4 cm to 15.5 cm.

CONCLUSION

Using the clinical volumes of injectate that we use for upper extremity nerves and the sciatic nerve, positioning adjacent to the deep surface of each nerve was sufficient to produce circumferential coating of the nerve, except in the tight fibroosseous space of the carpal tunnel.

CLINICAL RELEVANCE/APPLICATION

We no longer try to position the needle adjacent to two opposite sides of a nerve during ultrasound-guided perineural injections, except in the carpal tunnel.

VSMK31-07

Evaluating Bone Neoplasia: Ultrasound-guided Biopsy vs. Computed Tomography-guided Biopsy


PURPOSE

To compare the diagnostic accuracy of ultrasound (US)-guided biopsy with computed tomography (CT)-guided biopsy, regarding primary and metastatic bone lesions.

METHOD AND MATERIALS

A retrospective review was performed on 116 patients presenting with lesions of the appendicular skeleton and shoulder girdle that were suspicious for primary or metastatic bone malignancy. All patients underwent percutaneous needle core biopsy and/or fine needle aspiration (FNA) using CT (n = 83) or ultrasound (n = 33) guidance. Samples obtained by CT and ultrasound were then stratified by lesion characteristics (size, ...
radiographic features, location), biopsy type (core vs FNA), and categorized as either Group A - Diagnostic or Group B - non-diagnostic. Diagnostic accuracy was based on comparison to surgical pathology and clinical outcome.

RESULTS
Overall accuracy of US-guided cases was 87.9% (29/33) whereas for CT-guided cases it was 87.9% (72/83). Biopsy results were further broken down by lesion size. For US, 88.9% of lesions 0-3cm were diagnostic, 85.7% of lesions 4-6cm were diagnostic, and 90% of lesions greater than 6cm were diagnostic. For CT, 80.0% of lesions 0-3cm were diagnostic, 92.9% of lesions 4-6cm were diagnostic and 81.3% of lesions greater than 6cm were diagnostic.

CONCLUSION
Ultrasound and CT have comparable diagnostic accuracy in the sampling of bone lesions, regardless of size.

CLINICAL RELEVANCE/APPLICATION
With comparable accuracy to CT and the benefits of lower cost, lack of radiation, and the ability to perform procedures at bedside, ultrasound is an ideal method for clinicians to investigate suspicious osseous lesions.

VSMK31-08  
Sonography for Evaluation of Arthritis (Demonstration)
Etienne Cardinal MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To demonstrate comprehensive methods to evaluate joints for arthritis.

VSMK31-09  
Ultrasound Findings in Hand Joints Involvement in Patients with Psoriatic Arthritis and Its Correlation with Clinical DAS28 Score
Priyanka Mahadeorao Naranje MBBS, MD (Presenter): Nothing to Disclose, Mahesh Prakash MBBS, MD: Nothing to Disclose, Aman Sharma: Nothing to Disclose, Sunil Dogra MBBS, MD: Nothing to Disclose, Niranjan Khandelwal MD: Nothing to Disclose

PURPOSE
To evaluate the ultrasound findings in hand joints in patients with psoriatic arthritis and correlate grayscale and power Doppler ultrasonography findings with Disease Activity Score 28.

METHOD AND MATERIALS
This prospective study was performed in 30 patients. Ultrasound evaluation of 28 joints of both hands was undertaken and various findings were recorded including synovial hypertrophy, power Doppler abnormality, soft tissue thickening, tenosynovitis, joint effusion, periosteal reaction and erosions. Composite ultrasound scores and Disease Activity Score 28 were calculated and compared.

RESULTS
Ultrasound detected more abnormalities in the hand joints than did clinical examination. The frequency of various ultrasound abnormalities were as follows: Synovial hypertrophy was seen in 100%, power Doppler abnormality suggesting hypervascularity in 36.7%, soft tissue thickening in 66.7%, periosteal reaction in 33.3%, erosions in 30% (mostly in DIP andPIP joints) and flexor tendonitis in 6.7% of patients. Significant correlation was found between Disease activity score 28 and gray-scale joint score (GSJS) (Spearman’s ρ: 0.499, P: 0.005) gray-scale joint count (GSJC) (ρ: 0.398, P: 0.029) and power Doppler joint score (PDJS) (ρ: 0.367, P: 0.046). There was a statistically significant difference between remission and low disease activity group, and moderate disease activity group in terms of GSJC, GSJS, PDJC and PDJS (P<0.05). These ultrasound measures were higher in moderate disease activity zone patients.

CONCLUSION
Ultrasound is a useful modality for the objective assessment of psoriatic arthritis, which can detect joint inflammation to a larger extent than clinically expected. Ultrasound including power Doppler can be used as a modality for assessment of severity of psoriatic arthritis as it correlates with the clinical scoring.

CLINICAL RELEVANCE/APPLICATION
Ultrasound including power Doppler is a very good modality for assessment of severity of psoriatic arthritis.

VSMK31-10  
Rhumatoid Arthritis: Correlations between Ultrasound and Radiographic Images and between Ultrasound and Clinical Findings
Manel Limeme: Nothing to Disclose, Neila Benzina: Nothing to Disclose, Moncef Allegue MD: Nothing to Disclose, Houneida Zaghouani Ben Alaya: Nothing to Disclose, Senda Majdoub: Nothing to Disclose, habib amara: Nothing to Disclose, dejla bakir: Nothing to Disclose, Chakib Kraiem MD, DMD (Presenter): Nothing to Disclose

PURPOSE

VSMK31-09
To evaluate concordance between clinical examination and ultrasound of joints (hands) in an heterogeneous group of patients with rheumatoid arthritis (RA). To compare sonography with conventional radiography for the detection of erosions in the metacarpophalangeal (MCP) joints of patients with RA.

**METHOD AND MATERIALS**

Forty patients were included in a prospective, transversal, single-center study, whatever disease activity, duration or treatment. In each patient, both hands were evaluated for a total of 960 joints. Synovitis was scored using clinical examination, B-mode and power Doppler. Concordance between swelling joint by clinical examination, synovitis thickening by B-mode (grade 1 or higher) and inflammation by power Doppler (grade 1 or higher) was assessed by computing the kappa coefficient. Erosion sites were recorded using radiography and sonography and subsequently compared using each modality.

**RESULTS**

Clinical joint examination and ultrasound concordance was very low at the metacarpophalangeal joints ($\kappa < 0.1$) and was low at wrists ($\kappa: 0.23$ to $0.30$). B-mode and power Doppler found 350 more synovitis than swollen joint count using clinical examination and up to 228 times more at metacarpophalangeal joints. Sonography detected 127 definite erosions in 56 of 100 RA patients, compared with radiographic detection of 32 erosions (26 % of which coincided with sonographic erosions) in 17 of 100 patients ($P < 0.0001$). The mean duration from the onset of symptoms was 3.46 months. Based on the clinical, biochemical and US scores the patients from our study presented early stages of RA. Also, statistically significant correlations were observed between the time elapsed from the onset, the changes highlighted by ultrasound and the stage of the disease.

**CONCLUSION**

Our study confirms that US evaluation of changes in the joints of the hand offers useful information for staging the diagnosis of RA as it determines the activity of the disease thanks to Doppler parameters. It is a reliable technique that detects more erosions than radiography, especially in early RA. This technology has potential in the management of patients with early RA and is likely to have major implications for the future practice of rheumatology.

**CLINICAL RELEVANCE/APPLICATION**

US evaluation of changes in the joints of the hand offers useful information for staging the diagnosis of RA as it determines the activity of the disease thanks to Doppler parameters.

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**VSMK31-11**

**Supersonic Shear Imaging Identifies Potential Evidence of Localized Changes in Achilles Tendon Compliance in Middle-aged Adults**

Laura Slane PhD (Presenter): Nothing to Disclose, Ryan J. DeWall PhD: Nothing to Disclose, Jack Martin: Nothing to Disclose, Kenneth S. Lee MD: Research Consultant, SuperSonic Imagine Speakers Bureau, Medical Technology Management Institute, Darryl Thelen: Nothing to Disclose

**PURPOSE**

Middle-aged adults exhibit increased incidence of Achilles tendon and calf muscle strain injuries. Age-related changes in tendon compliance are hypothesized to be a contributing factor, but assessing tissue compliance in vivo remains challenging. Supersonic Shear Imaging is an ultrasound elastography approach that noninvasively evaluates tissue compliance by measuring shear wave propagation speed (SWS). The purpose of this study was to compare spatial variations in SWS within the Achilles tendons of young and middle-aged adults.

**METHOD AND MATERIALS**

We recruited ten healthy young (27±4 yrs) and middle-aged adults (49±4 yrs). SWS images were collected from regions of the Achilles tendon, including the free tendon, the soleus aponeurosis and the medial gastrocnemius aponeurosis, at three ankle angles: resting (R), dorsiflexed (R-15 deg) and plantarflexed (R+15 deg). SWS data were evaluated post-hoc at regions of interest defined within tendon boundaries.

**RESULTS**

Achilles tendon SWS varied significantly with imaging location, with the greatest speeds measured in the free tendon. Ankle posture had a significant effect on SWS, with speed progressively increasing with ankle dorsiflexion along the entire tendon length. A significant, inverse relationship between resting gastrocnemius aponeurosis SWS and age ($R^2=0.34$, $p<0.01$) was observed, but there were no age-effects in the free tendon or soleus aponeurosis. A similar relationship existed in the gastrocnemius aponeurosis in the dorsiflexed posture ($R^2=0.55$, $p<0.01$).

**CONCLUSION**

We observed age-related changes in Achilles tendon SWS to be location dependent, with evidence of a significant increase in compliance in the gastrocnemius aponeurosis of middle-aged adults. Our results suggest that Achilles tendon compliance increases in a distal-to-proximal fashion, with greater compliance at the muscle-tendon junction. Middle-aged adults seem to exhibit greater tendon compliance near the muscle-tendon junction, which could give rise to localized tissue strain concentrations and hence injury risk.

**CLINICAL RELEVANCE/APPLICATION**

These results demonstrate the potential for Supersonic Shear Imaging to quantitatively characterize spatial variations in tendon elasticity that may be affected by aging, injury and disease processes.
EVALUATION OF THE MEDIAN NERVE AND CARPAL TUNNEL TENDONS IN PATIENTS WITH CARPAL TUNNEL SYNDROME USING TRANSIENT ELASTOGRAPHY

Renata La Rocca Vieira MD (Presenter): Nothing to Disclose, Ronald Steven Adler MD, PhD: Nothing to Disclose, Kiril Kiprovski: Nothing to Disclose, James S. Babb PhD: Nothing to Disclose

PURPOSE

Carpal tunnel syndrome (CTS) is caused by compression or irritation of the median nerve (MN) within the carpal tunnel (CT). The diagnosis of CTS might be challenging given the lack of typical clinical or EMG findings. We aim to prospectively determine whether shear wave analysis provides useful adjunctive and quantitative information regarding the diagnosis of CTS.

METHOD AND MATERIALS

This prospective work in progress included 5 patients-10 wrists (5 F, age range 41-70y, mean 55.6y) with clinically proven CTS and 4 healthy volunteer- 8 wrists (4 F, age range 32-45y, mean 39y). In both groups, the following measurements were performed: MN cross-sectional areas (CSA) in the CT and in the pronator quadratus (PQ); shear wave velocities in the longitudinal and axial planes (SWV) for MN and CT tendons. The differences between CTS patients and controls with regards to MN CSA and MN and tendon velocities were assessed with 9MHz linear transducer and S3000 scanner (Siemens, Mountainview, CA). A 2-dimension parametric SWV image was generated, from which selective SWV could be calculated.

RESULTS

The CSA in the patients with CTS was significantly higher than those in the volunteers (p<0.001). In the CTS group, the difference between MN CSA in CT and PQ was significant (p=0.006). The tendon velocity was significantly higher in the CTS group compared to controls, in both axial (p < 0.017) and longitudinal (p < 0.001) planes. No significant difference was found between the velocities of the MN in any plane between CTS and volunteers. The mean velocities/SD of the MN in the axial and longitudinal planes in the CTS group and volunteers are respectively 6.13/2.55 and 7.97/2.12 and 7.21/1.67 and 7.59/0.83. The difference between the velocities of the MN in the longitudinal versus axial planes is significant (p=0.011) in the CTS group.

CONCLUSION

The stiffness of the CT tendons is significantly higher in patients with CTS. Preliminary data did not find significant difference between the velocities of the MN between CTS and volunteers, likely due to small sample size. Interestingly, the difference between the velocities of the MN in the longitudinal versus axial planes is significant probably due to anisotropy.

CLINICAL RELEVANCE/APPLICATION

The pathophysiology of CTS is a combination of increased CT pressure and ischemic injury in the MN. Our results suggest the same theory can be applied to the tendons in the CT in patients with CTS.

SUPERB MICROVASCULAR IMAGING (SMI) AND DETECTION OF LOW GRADE MUSCULOSKELETAL INFLAMMATION

Adrian Kuok Pheng Lim MD, FRCR (Presenter): Luminary, Toshiba Corporation, Keshthra Satcithananda MBBS: Committee member, Johnson & Johnson, Sonya Abraham: Nothing to Disclose, David Owen Cosgrove MBChB, FRCR: Research Consultant, SuperSonic Imagine Research Consultant, Bracco Group Speakers Bureau, Toshiba Corporation

PURPOSE

To assess the efficacy of Superb Microvascular Imaging (SMI) in detecting low grade inflammation in joints and tendons compared with conventional Power Doppler ultrasound (PDUS).

METHOD AND MATERIALS

SMI is a new and sensitive Doppler technology designed to detect slow flowing microvasculature. We assessed it in patients who presented for routine MSK ultrasound (Aplio 500, Toshiba Medical Systems). The grey-scale, PDUS and SMI findings of each study were recorded on video clips. The joints and tendons which demonstrated an abnormality or vascular signal on either grey-scale appearance, PDUS or SMI were included in the analysis.

Three radiologists with over 10 years experience individually in MSK ultrasound assessed the images and scored whether there were grey-scale changes, signal on PDUS and/or SMI within the joints or tendons examined. If signal was detected on PDUS and SMI, they also scored a four point scale comparing the two Doppler techniques (no difference, mildly, moderately or markedly better).

RESULTS

50 cases have been analyzed to date, comprising of 36 joints, 9 tendons, and 5 superficial lumps. In all cases, patients were symptomatic with joint pain or a palpable lump and 12 had a history of an inflammatory arthropathy. There was very good agreement between the readers (Kappa = 0.85). 29 cases demonstrated vascular flow with both PD and SMI while in 5 cases, no flow was detected with either technique. In 16 cases, vascular flow was detected with SMI and not with PDUS (Fisher’s exact test: p = 0.02). Out of the 29 patients with vascular flow on SMI and PDUS, 3 showed no difference; while SMI scored moderately or markedly better in 20 cases (Chi2: p<0.02). In 12 patients, the SMI findings altered patient management where they either received an ultrasound guided steroid injection or started oral analgesia and/or disease modifying treatment.

CONCLUSION

SMI is a revolutionary Doppler technique which not only improves the visualisation of the microvasculature but
allows detection of low grade inflammation not previously visualised with Power Doppler. This has significant clinical impact leading to a change in management in 25% of the patients in this study population.

**CLINICAL RELEVANCE/APPLICATION**

The improved sensitivity of SMI compared with the current 'gold standard' Power Doppler, allows the detection of low grade inflammation not possible with Power Doppler which would significantly influence patient treatment.

**Interesting Musculoskeletal Ultrasound Cases**

Benjamin David Levine MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Be familiar with important topics in musculoskeletal ultrasound.

**ABSTRACT**

The goal of this presentation is to emphasize important teaching points through a series of interesting musculoskeletal ultrasound cases. Ultrasound imaging features of various musculoskeletal disease processes will be highlighted, along with review of case specific anatomy and technique.

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**VSNM31**

**Nuclear Medicine Series: Non-FDG PET Radiotracers in Oncology**

**Series Courses**

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

Tue, Dec 2 8:30 AM - 12:00 PM Location: SS05A

**Participants**

Moderator: Hossein Jadvar MD, PhD: Nothing to Disclose

- **Sub-Events**

  **VSNM31-01** Proliferation Imaging: FLT/PET in Oncology

  David A. Mankoff MD, PhD (Presenter): Speaker, Koninklijke Philips NV Speaker, Siemens AG Speaker, General Electric Company

  **LEARNING OBJECTIVES**

  1) Describe the kinetics of thymidine relevant to FLT PET imaging. 2) Discuss approaches to FLT image interpretation. 3) Describe studies that have tested FLT PET as a marker cancer response to treatment.

  **VSNM31-02** Prospective Evaluation of 124I-CLR1404 PET/CT in Glioma


  **PURPOSE**

  MR imaging of primary brain tumors has limited value for assessing the extent of tumor infiltration and differentiating tumor recurrence from pseudoprogression. Molecular imaging has the potential to overcome these limitations. CLR1404 is a novel alkylphosphocholine analogue characterized by preferential uptake and prolonged retention in cancer cells and cancer stem cells. Here, we report on the first-in-human use of 124I-CLR1404 PET/CT in primary and recurrent glioma.

  **METHOD AND MATERIALS**

  4 patients with low grade and 7 patients with high grade glioma were injected with 74 or 185 MBq of 124I-CLR1404 and imaged with PET/CT at 6, 24, and 48 hrs post-infusion. The majority of patients (10/11) had suspected recurrent disease. In patients with uptake above background, tumor to background ratios (T:B) were generated and T1 MRI-Gad+ volumes, SUV threshold volumes (1.0, 1.2), and T:B ratio threshold volumes (1.6, 2.0) were segmented. In addition, T:B lesion kinetics were analyzed.

  **RESULTS**

  124I-CLR1404 PET demonstrated avid tumor uptake above background in 7 of 11 patients. Three low grade
gliomas and one high grade did not show uptake. With clinical follow-up, two of the three low grade gliomas and the high grade glioma were shown to be pseudoprogression and not tumor recurrence. In positive patients, uptake was observed both in areas with and without Gadolinium enhancement on MRI. There was no significant uptake in normal brain. Maximum T:B ratios were 11.3±3.9 at 24 hrs (range 5.7-15.6) and 10.8±2.9 at 48 hrs (range 6.4-14.0). Average tumor volumes (in mL) were 4.6 (range 0.2-7.6) for Gad+ MRI, 59.1 (range 33.6-91.0) for PET T:B 1.6, 47.2 (range 28.8-66.3) for PET T:B 2.0, 17.4 (range 5.1-35.3) for SUV 1.0, and 12.3 (range 1.7-28.7) for SUV 1.2.

CONCLUSION

$^{124}$I-CLR1404 PET/CT successfully images glioma and demonstrates high tumor-to-background contrast and larger lesion volumes than contrast-enhanced MRI. $^{124}$I-CLR1404 PET provides tumor-specific molecular imaging that may be valuable for the identification of tumor margin and the differentiation of treatment related changes from tumor progression.

CLINICAL RELEVANCE/APPLICATION

$^{124}$I-CLR1404 PET/CT demonstrates differential, high contrast uptake as well as larger lesion volumes than CE MRI in glioma and may help distinguish treatment related changes from disease progression.

Comparison of $^{11}$C-acetate PET/CT for the Evaluation of Newly Diagnosed and Relapsed Myeloma

Sirong Chen (Presenter): Nothing to Disclose, William Cheung: Nothing to Disclose, Yim Lung Leung: Nothing to Disclose, Thomas KC Cheng MBBS: Nothing to Disclose, Ka Nin Wong: Nothing to Disclose, Chor Sang Chim: Nothing to Disclose, Chi Lai Ho: Nothing to Disclose

PURPOSE

$^{11}$C-acetate PET/CT is useful for the detection of multiple myeloma (MM) because it was previously shown that myeloma cell lines prefer fatty acid over glucose metabolism for growth. We aim to compare the diagnostic value of $^{11}$C-acetate PET/CT in relapsed MM with treatment naive MM patients.

METHOD AND MATERIALS

From year 2010 to 2013, 66 MM patients were referred for $^{11}$C-acetate PET/CT: 37 relapsed (M: 23, F: 14; mean age=61.4±7.7y) and 29 newly diagnosed (M: 17, F: 12; mean age=63.1±10.6y). All patients were confirmed by trephine bone marrow biopsy. 20 subjects with normal marrow were recruited as controls (M: 12, F: 8; mean age=59.8±10.9y). Active myeloma disease was first visually assessed as having focal or diffuse pattern on PET. SUV$_{\text{max}}$ of L3 was chosen as the representative site for quantitative assessment of marrow disease activity for patients with diffuse MM. ROC analysis was performed between MM and normal subjects to define the individual SUV$_{\text{max}}$ L3 cut-off values for newly diagnosed and relapsed patients with diffuse MM pattern.

RESULTS

For the detection of focal MM, $^{11}$C-acetate PET/CT had a detection sensitivity of relapsed MM (31/33: 93.9%) comparable to that of newly diagnosed MM (15/16: 93.8%). For diffuse MM, the ROC-defined thresholds of SUV$_{\text{max}}$ L3 were 3.78 and 3.80 (AUC=0.97 vs 0.97) in relapsed and newly diagnosed groups, respectively. At these thresholds, $^{11}$C-acetate PET/CT had a slightly better sensitivity for detection of diffuse MM in the relapsed group (22/25: 88.0%) than newly diagnosed group (22/27: 81.5%). The average marrow activity in relapsed group was higher than that of newly diagnosed group (SUV$_{\text{max}}$ L3=6.57±3.59 vs 5.10±1.78, P=0.065), suggesting that relapsed MM patients had more severe marrow infiltration. The overall detection sensitivity of focal and/or diffuse MM disease by $^{11}$C-acetate PET/CT was also slightly better in relapsed (34/37: 91.9%) than in newly diagnosed MM (24/29: 82.8%) patients.

CONCLUSION

$^{11}$C-acetate PET/CT is sensitive for detection of both relapsed and newly diagnosed MM. It has even better diagnostic performance in relapsed patients with diffuse MM pattern, which is the group of MM patients known to have the greatest diagnostic challenge.

CLINICAL RELEVANCE/APPLICATION

In addition to its high detection sensitivity in newly diagnosed MM, $^{11}$C-acetate PET/CT is also sensitive in assessment of MM relapse, hence with potential to suggest when to re-initiate treatment.

Bone PET Imaging: NaF PET in Oncology

Baris Turkbey MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To identify the advantages of F-18 NaF PET/CT imaging in oncology. 2) To understand the importance of a standardized imaging protocol. 3) To become comfortable differentiating benign from malignant lesions on F-18 NaF PET/CT.

ABSTRACT
F-18 NaF PET/CT has been shown to have higher sensitivity and specificity than planar 99m-Tc MDP bone scanning in several small studies. The concomitant acquisition of anatomie images permits immediate correlation of any abnormal findings. Additionally, F-18 NaF PET/CT bone imaging can be quantitated, allowing bone disease to be “measurable”, increasing its utility therapy monitoring. When a consistent F-18 NaF uptake period is used, the SUV values are highly reproducible, and due to the high extraction fraction, high quality images can be obtained with a radiation dose exposure similar to that of Tc-99m MDP (including the low dose CT scan). This presentation will discuss the benefits and challenges of F-18 NaF PET/CT in oncology.

VSNM31-05  
C11-Acetate PET/CT and F18 Sodium Fluoride PET Bone Imaging in the Detection of Skeletal Metastasis in Biochemically Recurrent Prostate Adenocarcinoma (PCa)

Fabio Almeida MD (Presenter): Nothing to Disclose, Mark Scholz MD: Nothing to Disclose, Richard Lam MD: Nothing to Disclose, Jeffrey Turner MD: Nothing to Disclose, Charles Myers MD: Nothing to Disclose, Elisa Blackwell: Nothing to Disclose

PURPOSE

This study compared C11-Acetate (CA) positron emission tomography (PET/CT) and F18 Sodium Fluoride (F18-NaF) PET bone imaging for the detection of skeletal metastasis in men with biochemically recurrent PCa.

METHOD AND MATERIALS

Men with PCa previously having had definitive therapy demonstrating a rising PSAs were evaluated retrospectively. CA PET/CT studies where performed and F18-NaF PET performed within 2 months was compared. Imaging studies were reviewed for the presence/absence of skeletal lesions, and for concordance in the number of detected lesions. Detection rates of soft tissue lesions was also evaluated on the CA PET studies in relation to the presence/absence of skeletal lesions. PSA kinetics were evaluated.

RESULTS

183 studies (men age 45 - 88) met our criteria for image review. PSA ranged from 0.5 - 148 (median 2.5). CA PET detected skeletal lesions in 59 (32%) of studies, whereas F18-NaF PET detected lesions in 75 (41%). In 22 studies, CA PET and F18-NaF where concordant, demonstrating a solitary bony lesion in 14 and multiple bony lesions in 7. 57 studies were discordant. F18-NaF PET demonstrated lesions not seen on CA PET in 36 (20%) studies (median PSA 3.05, median PSA doubling time[dt] 4 months). CA PET found bony lesions in 14 studies (8%) not present on the F18-NaF studies. In 7 studies there were non-specific findings on the F18-NaF study that where negative on the CA PET and therefor felt to be benign. In studies positive for bony lesions, CA PET additionally identified soft tissue lesions in 31 (17%) studies. In 78 (42%) studies CA PET identified soft tissue lesions when no bone lesions were found in either CA PET or F18-NaF (median PSA 2.36, median PSAdt 5 months). These lesions were found to be in the pelvis in 61 (33%), extrapelvic regions in 6 (3%) and involving both pelvic and extrapelvic soft tissue sites in 11 (6%).

CONCLUSION

CA PET and F18-NaF PET are useful and appear complimentary for the detection of skeletal metastasis in patients with biochemical recurrence of PCa, but do show discordance in their detection rates. CA PET also detected soft tissue lesions in most patients negative for bone lesions. PSA kinetics do not appear to help select one imaging study over the other.

CLINICAL RELEVANCE/APPLICATION

PCa recurrence after definitive treatment occurs in up to 40% of patients. Conventional imaging is of limited value in detection in early biochemical recurrence, thereby limiting treatment options.

VSNM31-06  
PSA Sensitivity of 18F-NaF PET for Detection of First Bone Metastases in Biochemical Recurrence of Prostate Cancer after Prostatectomy

Leslie Ballas MD (Presenter): Nothing to Disclose, James Yoon BA: Nothing to Disclose, Bhushan Desai MBBS, MS: Nothing to Disclose, Hossein Jadvar MD, PhD: Nothing to Disclose

PURPOSE

To associate NaF PET findings for first bone metastases with PSA values and kinetics in patients with biochemical recurrence in the post-prostatectomy setting.

METHOD AND MATERIALS

All NaF PET scans that were performed at USC between 2010 and 2014 were queried to find patients who had undergone radical prostatectomy. We excluded patients who had known metastatic disease at the time of NaF PET to obtain a cohort of patients for whom NaF PET was being used to determine first osseous metastases. The electronic medical records of the patients were then reviewed to extract information on PSA at the time of NaF PET, PSA kinetics, pathologic features of the prostatectomy specimen, as well as other radiologic studies performed to validate the NaF PET findings.

RESULTS

56 patients met our inclusion criteria; of which, 11 (19.6%) had positive NaF PET scans. The average PSA for patients with a positive NaF PET was 6.25 ng/mL (range 0.04- 30.38 ng/mL). There were 14 patients who had imaging studies with PSA values below 0.2ng/mL; 3 of those patients (21%) had positive scans.. The average PSA velocity of patients with positive NaF PET was 0.34 ng/ml/mo (range 0.02 to 2.25 ng/ml/mo), the average PSA doubling-time amongst the patients with positive scans was 9.92 months (range 1.22 - 36.32 months). Of those with positive NaF PET scans, 4 had other imaging modalities that confirmed the existence of bone abnormalities and all 11 were treated for progression of disease based on the findings of the NaF PET scans.
CONCLUSION
NAF PET detected first osseous metastatic disease in 19.6% of patients with PSA relapse in this population of patients. The test was able to detect early metastatic disease in 3 of 14 patients with PSA values.

CLINICAL RELEVANCE/APPLICATION
NAF PET has the ability to detect early prostate cancer bone metastases in the post-prostatectomy setting. (This work was done with grant support from Dr. Jadvar's NIH/NCI Grant R01-CA111613).

VSNM31-07
Prostate Cancer Choline PET Imaging and Other PET Tracers
Hossein Jadvar MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Review the major biological targets that may be useful for imaging in prostate cancer. 2) Understand the need for tailoring the imaging technique to the particular clinical phase of disease. 3) Analyze the current evidence with the potential utility of PET with various radiotracers in the imaging evaluation of prostate cancer.

ABSTRACT
Recent advances in the fundamental understanding of the complex biology of prostate cancer have provided increasing number of potential targets for imaging and treatment. In this presentation, I review the experience with a number of major PET radiotracers for potential use in the imaging evaluation of men with prostate cancer.

Comparison of 68Ga-labelled PSMA- and 11C-Choline PET/CT for the Detection of Recurrent Prostate Cancer
Hansjoerg Rempp (Presenter): Nothing to Disclose, Johannes Schwenck: Nothing to Disclose, Gerald Reischl MD, PhD: Nothing to Disclose, Konstantin Nikolau MD: Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Christian la Fougere: Nothing to Disclose, Christina Pfannenberg MD: Nothing to Disclose

PURPOSE
The 68Ga-labelled PSMA (prostate specific membrane antigen) ligand is a highly promising tracer for imaging of recurrent prostate cancer (PC). The aim of the study was to compare this novel tracer with the standard 11C-Choline based PET/CT.

METHOD AND MATERIALS
42 patients with suspected PC relapse underwent a PET/CT 5 min p.i. of 615±26 MBq 11C-Choline and 60 min p.i. of 157±16 MBq 68Ga-HBED-CC-PSMA. The examinations were performed on the same day. 39 patients had a biochemical relapse after prostatectomy and/or radiotherapy (mean PSA 8.3 ng/ml, range 0.3-64 ng/ml, median 3.3 ng/ml), 3 patients had a primary staging. Suspicious lesions were evaluated visually and semiquantitatively (mean SUV, standard uptake value and T/B, tumor to blood ratio).

RESULTS
In 36/42 patients, at least one lesion suspicious for cancer could be detected using 68Ga-PSMA (detection rate 85.7%), while at least one lesion could be found by 11C-Choline in 34/42 patients (detection rate 81.0%). In five patients no lesion was found in both methods. Twelve patients had local recurrences, whereof 11/12 relapses were detected by both methods. One local relapse was not detected by 68Ga-PSMA. In 1/3 patients with primary staging the tumor could not be detected by either of the tracers. In 28 patients suspicious lymph nodes (LN) were detected. 89% of these patients had at least one PSMA-positive LN, 89% of them had at least one Choline-positive LN. Among all 98 suspicious LN, 86 were PSMA-positive and 80 were Choline-positive. 18 LN were PSMA-positive only, 12 were Choline-positive only. Mean size of the LN which could only be detected by PSMA was 8±3 mm. SUV mean and T/B ratio of the LN was clearly higher using 68Ga-PSMA (15.3±4) than using 11C-Choline (4.4±2). Bone metastases were found in 14 patients, the number of detected lesions as well as tracer uptake was clearly higher using 68Ga-PSMA (SUV mean 11.4±8.4 vs 6±3.2). In one patient bone metastases were only detected with 68Ga-PSMA PET. In only 8/14 patients, bone metastases could be detected in CT.

CONCLUSION
68Ga-PSMA-PET/CT is able to detect recurrent PC with a higher detection rate compared to the standard 11C-Choline PET/CT and has an improved T/B ratio. However, 68Ga-PSMA was not able to detect all primary and metastatic sites.

CLINICAL RELEVANCE/APPLICATION
68Ga-PSMA is a new tracer for prostate cancer, promising particularly for detection of recurrence in patients with low PSA.

VSNM31-09
The Role of PET/CT Imaging with the 68Ga-labelled PSMA-ligand HBED-CC in the Diagnosis of Recurrent Prostate Cancer
Ali Afshar-Oromieh (Presenter): Nothing to Disclose, Eleni Avtzi: Nothing to Disclose, Matthias Eder: Nothing to Disclose, Michael Eisenhut: Nothing to Disclose, Tim Holland-Letz: Nothing to Disclose, Silvan Boxler: Nothing to Disclose, Boris Hadaschik: Nothing to Disclose, Clemens Kratochwil MD: VSNM31-09
PURPOSE

Since the introduction of PET-imaging with the 68Ga-labelled PSMA ligand HBED-CC, this highly promising method has rapidly spread out across many countries. There exists evidence, that this imaging method might be a significant step forward in the diagnosis of prostate cancer (PCa). The aim of this study was to evaluate the role and valence of the 68Ga-PSMA-PET/CT in the diagnosis of PCa.

METHOD AND MATERIALS

We performed a retrospective analysis of 319 patients who were investigated by 68Ga-PSMA-PET/CT. Mean Gleason Score (GSC) was 7.5, median PSA level 4.6 ng/ml. Possible influence of several factors (PSA level, GSC, hormonal therapy, age, applied amount of injected tracer) were evaluated. 41 Patients were investigated by biopsy after PET/CT. Tracer uptake was measured in 901 representative tumor lesions.

RESULTS

In 82.8% of the patients at least one lesion indicative for PCa was detected. Current hormonal therapy had no negative influence on the detection rate. High amounts of injected tracer did not improve the probability to detect tumor suspicious lesions. Tumor detection showed a positive association with PSA level. GSC did not show an influence on tumor detection. Mean SUVmax of all tumor lesions was 13.3 ± 14.6. Only three of all histopathologically investigated lesions were false negative in PSMA-PET/CT, all others (n=304) were true negative and positive.

CONCLUSION

68Ga-PSMA-PET/CT can detect PCa with high sensitivity. In addition, the tracer is highly specific for PCa. Detection of PCa can be improved by higher PSA level. Current hormonal therapy did not influence the detection rate negatively. GSC did not show an influence on tumor detection.

CLINICAL RELEVANCE/APPLICATION

Introduced in 2011, PET-imaging with the 68Ga-labelled PSMA-ligand HBED-CC has rapidly spread out across many countries. This new method of imaging is thought to be a significant step forward in the diagnosis of recurrent prostate cancer.
Patients with histologically confirmed NET and available follow-up of at least 6 months (median 12.6 months; range 6.1-23.2) were included. PET/CT and ceCT images were analyzed separately by two blinded nuclear medicine physicians and two radiologists, respectively. Finally all investigators reviewed all detected lesion together reaching a consensus-grading for PET/CT. The results were then compared to the reference standard consisting of clinical follow-up data

RESULTS

Regarding true positive lesions, PET/CT detected: 139 bone-lesions vs. 48 (ceCT), 106 lymph node metastases (PET/CT) vs. 71 (CT) and 26 lung lesions (PET/CT and CT each). On a patient basis, PET/CT achieved a higher sensitivity (100% vs. 47%) and specificity (89% vs. 49%) for bones than stand-alone ceCT. For lymph nodes the effect was similar (sensitivity 92% vs. 64% and specificity 83% vs. 59%). For the detection of pulmonary lesions the sensitivity was identical (100%) while specificity of PET/CT was superior to CT-alone (95% vs. 82%)

CONCLUSION

In summary, the use of Gallium-68-DOTATATE-PET-CT appears to lead to an increase in sensitivity and specificity for the detection of extra-hepatic NET metastases compared to stand-alone ceCT

CLINICAL RELEVANCE/APPLICATION

use of 68Ga-DOTATATE PET/CT appears to lead to an increase in quality for the detection of extra-hepatic NET metastases compared to stand-alone ceCT
Sub-Events

VSPD31-01  Peripheral Vasc Imaging Technical Tips
Shreyas Shreenivas Vasanawala MD, PhD (Presenter): Research collaboration, General Electric Company Stockholder, Morpheus Imaging, Inc

LEARNING OBJECTIVES

1) Know an approach to the choice of contrast agent for peripheral vascular imaging. 2) Know indications for non-contrast and pre-contrast imaging. 3) Know the types of fat suppression and how to pick which method to use. 4) Know sequence parameter modifications that enable imaging within stents.

ABSTRACT

This presentation will focus on methods of optimizing the MR imaging of peripheral vessels, addressing four questions. The first question is which contrast agent to choose. Most MR imaging can be performed with standard extracellular gadolinium agents. However, there are some advantages and disadvantages of blood pool agents that will be discussed. Next, situations when pre-contrast or non-contrast imaging is necessary are covered. Mostly, these sequences are only necessary in situations where the technical quality of post-contrast imaging is in doubt. Third, approaches to fat suppression will be covered. The benefits and disadvantages of two-point Dixon methods compared with subtraction and spectrally selective suppression will be reviewed. Finally, MR imaging in the presence of vascular stents will be covered, including sequence modifications that enable visualization within the stents.

Validation of Quantitative Phase Contrast MRI Assessment of Cerebral Haemo/Hydro Dynamics in Children

Eusra Hassan (Presenter): Nothing to Disclose, John Caine: Nothing to Disclose, Stavros Michael Stivaros PhD, FRCR: Medical Director, Obsidian Health Limited

PURPOSE

Quantitative phase contrast MRI (PCMRI) enables the flow of blood or CSF to be measured over a cardiac cycle. PCMRI in children presents unique challenges in implementation relating to ECG acquisition technique and MRI scanning parameters which this study investigates.

METHOD AND MATERIALS

PCMRI was performed to measure flow through the right and left internal carotid and basilar arteries (rICA, lICA, BA), superior sagittal sinus (SSS), straight sinus vein (StrS), CSF through the foramen magnum (FM) and aqueduct of sylvius (AQ). Velocity encoding (venc) was varied based on evidence of under or or oversampling. PCMRI experiments were perfomed using central ECG gating and then repeated using peripheral pulse gating. The imaging was analysed by three experienced observers in the field of PCMRI analysis using the image analysis programme, Segment, to allow the respective flow rates to be calculated.

RESULTS

Data was collected from 16 children aged 1 to 15 years (mean 4 years 6 months). Nine children had central and peripheral pulse gating employed. The mean flow rates measured with peripheral gating was IICA = 0.094mls/s, right ICA = 0.092mls/s, BA = 0.056mls/s, SSS = 0.007mls/s, StrS = 0.001mls/s, FM = 0.01mls/s, AQ = 0.001mls/s. Mean flow rates with central ECG measurements were IICA = 0.091mls/s, rICA = 0.091mls/s, BA=0.057mls/s, SSS = 0.042mls/s, StrS = 0.006mls/s, FM = 0.003mls/s, AQ = 0.001mls/s. No significant statistical difference was detected based on the acquisition technique. Compared to published adult literature, the velocity encoding gradients (venc) in our childhood cohort were significantly different with arterial =120cm/s, venous=25cm/s and CSF=16cm/s.

CONCLUSION

Our data shows no significant difference with regard to peripheral versus central pulse measurement for PCMRI acquisition in children. Peripheral PCMRI acquisition is much easier to apply and better tolerated in the paediatric cohort. In addition this work provides child specific venc values for PCMRI assessment, which differs from published adult data.
CLINICAL RELEVANCE/APPLICATION

It is recognised that there exists a complex interaction between cerebral arterial, venous and CSF flow rates in hydrocephalus. Quantitative PCMRI allows for non-invasive assessment of these haemo/hydrodynamic flows which may one day supersede invasive intracranial monitoring. This work looks to develop and validate paediatric focused application of PCMRI for such applications.

VSPD31-03  Cardiac Phase-dependent Image Quality of the Coronaries in Pediatric Cardiac High Pitch Computed Tomography

Matthias Stefan May (Presenter): Speakers Bureau, Siemens AG, Wolfgang Wust MD: Nothing to Disclose, Michael Uder MD: Speakers Bureau, Bracco Group Research Grant, Siemens AG, Michael Marcus Lell MD: Research Grant, Siemens AG Speakers Bureau, Siemens AG Research Grant, Bayer AG Speakers Bureau, Bayer AG Research Consultant, Bracco Group, Oliver Rompel: Nothing to Disclose

PURPOSE

The purpose of this study was to retrospectively evaluate the best cardiac phase for visualization of the coronaries in children younger than 1 year undergoing Cardiac High Pitch Computed Tomography (CT). The study applies to the declaration of Helsinki.

METHOD AND MATERIALS

Cardiac CT was performed on a second generation Dual-Source CT in 95 Patients (median age 31 days, range 1-336 days) with a high-pitch protocol (p=3,2) at 80 kVp, automatic exposure control and a total collimation of 2x64x0.6mm. The ECG-trace was used as trigger for automated heart-phase (HP) selection. Retrospective data analysis was carried out in dependence of the HP (<20%/n=9, <30%/n=17, <40%/n=10, <50%/n=26, <60%/n=14, <70%/n=13, <80%/n=6). Motion artifacts in the coronary arteries were recorded for the proximal and distal segments on a 5-point Likert scale by two radiologists.

RESULTS

Mean heart rate was 137 bpm (andplusmn; 27 bpm) and was not statistically different between the HP-groups (p=0.629). Image quality of the coronary arteries was best at <50% and worst below 20% of the HP for both, the proximal and distal segments (pandlt;0.001). Visualization was still good and without statistically significant differences at andlt;40% for the proximal (p=0.13) and at andlt;40 and andlt;60% for the distal segments (p=0.27/0.06). Inter rater agreement was substantial (andkappa;=0.701).

CONCLUSION

Pediatric cardiac CT should be performed at 40-50% of the cardiac cycle in children below 1 year for best visualization of the coronaries.

CLINICAL RELEVANCE/APPLICATION

Technical settings undergoing pediatric cardiac CT should be optimized to obtain stable images at 40-50% of the HP.

VSPD31-04  4D Flow MRI Improves Hemodynamic Evaluation in Patients with D-transposition of the Great Arteries Following the Arterial Switch Operation Compared to 2D Phase Contrast MRI and Doppler Echocardiography

Marleen Vonder: Nothing to Disclose, Kelly Jarvis (Presenter): Nothing to Disclose, Susanne Schnell: Nothing to Disclose, Michael Markl PhD: Nothing to Disclose, Joshua D Robinson MD: Nothing to Disclose, Cynthia Karfias Rigsby MD: Nothing to Disclose, Bradley D. Allen MD: Nothing to Disclose, Alex Barker: Nothing to Disclose

PURPOSE

Pulmonary artery (PA) stenosis either at the anastomosis or in the branch PAs is the most common complication leading to intervention after the arterial switch operation (ASO) for D-transposition of the great arteries (DTGA). Accurately depicting PA stenosis is paramount for postop DTGA evaluation. 2D PC MRI (2D PC) or Doppler echo (echo) rely on velocity quantification in a single imaging plane and one-directional velocity encoding and may not detect the peak velocity across entire vessel segments. 4D flow provides 3-directional velocity encoding and full volumetric coverage of the great arteries and may improve hemodynamic evaluation. Our aim was to compare peak velocities measured by 2D PC and 4D flow with the gold standard echo in patients with DTGA s/p ASO.

METHOD AND MATERIALS

Eleven patients with DTGA s/p ASO who underwent 2D PC and 4D flow were included (mean age 13.2 y (range 1-30)). Peak velocities were measured in the ascending aorta (AAo), main (MPA), right (RPA), and left (LPA) pulmonary arteries. Echo data was available in 10/8/5/4 patients in the AAo/MPA/RPA/LPA. Peak velocities were
measured with: 1) a single cross section for 2D PC, 2) velocity maximum intensity projections (MIPs) of the entire aorta and PAs for 4D flow and 3) spectral Doppler for echo.

RESULTS

Significantly higher peak velocities were found with 4D flow than 2D PC in the AAo (1.27±0.37m/s vs 1.11±0.24m/s, p=0.021), MPA (2.22±1.71m/s vs 1.34±0.54m/s, p=0.006), RPA (2.20±0.67m/s vs 1.63±0.65m/s, p=0.026) and LPA (2.14±0.73m/s vs 1.64±0.69m/s, p=0.003) indicating the potential of 4D flow to provide improved stenosis assessment. Correlation analysis showed moderate to strong relationships between 4D and 2D PC in the AAo (R²=0.624), MPA (R²=0.696), RPA (R²=0.301) and LPA (R²=0.757) but consistent velocity underestimation by 2D PC (slopes of linear regression =0.38 - 0.82). No difference in peak velocity was found between 4D flow and echo for all vessels.

CONCLUSION

4D flow assessment of peak velocities in DTGA s/p ASO was similar to echo and superior to 2D PC which consistently underestimated peak velocities.

CLINICAL RELEVANCE/APPLICATION

Improved assessment of peak pulmonary artery velocities using 4D flow velocity MIPs in DTGA s/p ASO may more accurately depict significant stenoses.

VSPD31-05

The Application of 70 kV Technique Combined with Sinogram Affirmed Iterative Reconstruction (SAFIRE) in Infants with Total Anomalous Pulmonary Venous Connections: An Experimental Study with Dual-Source CT

Yan Wang MMed, MS (Presenter): Nothing to Disclose, Dapeng Shi: Nothing to Disclose

PURPOSE

To explore the application of dual source CT with ultra-low tube voltage (70kV) combined with iterative reconstruction algorithm (SAFIRE) in infants with total anomalous pulmonary venous connections.

METHOD AND MATERIALS

This prospective study was approved by institutional review board, and written informed consents were obtained from all patients' parents. Twenty three infants (13 male and 10 female, mean age 3 months, range 1-36 months, mean weight 5kg) suspected of total anomalous pulmonary venous connections (TAPCV) in our hospital, underwent cardiovascular examination with DSCT and trans-thoracic echocardiography (TTE) one week before surgery. All DSCT scans used the Flash mode with a tube voltage of 70 kV, and the tube current, amount of contrast medium and injection rate were adjusted according to patients' weight. Images were reconstructed with iterative reconstruction algorithm SAFIRE. DSCT and TTE results were compared with the results from surgery. Image quality was evaluated, and effective radiation dose (ED) was calculated.

RESULTS

All 23 cases were confirmed as TAPVA in operations. DSCT diagnosed all 23 cases, TTE missed 1 case; however 22 cases were diagnosed correctly as TAPVA with DSCT except one mixed type case, 16 cases were diagnosed correctly with TTE, and 3 mixed type cases were misdiagnosed, 1 infracardiac were diagnosed when information from CT was considered. Seventy three anomalous pulmonary veins were identified by DSCT, which results in a detection rate of 91.6%(73/76); 65 were identified by TTE, with a detection rate of 85.5%(65/76); 39 combined malformations were detected by DSCT among all 41 malformations from surgery, with a detection rate of 95.1%(39/41). For DSCT scans, image quality was good or excellent for 21 patients and diagnostic in 2 patients. The mean effective radiation dose ED was (0.95 ± 0.32) mSv.

CONCLUSION

DSCT Flash mode scans with combination of 70kV tube voltage technique and SAFIRE reconstruction algorithm can compensate for move artefacts caused by the rapid heart rate and free breathing in infants, improve the image quality, and perform CT examination with low radiation dose and less contrast medium.

CLINICAL RELEVANCE/APPLICATION

Flash mode on DSCT with a combination of 70kV tube voltage and iterative reconstruction algorithm SAFIRE has a good performance in infants with complicated TAPVC.

VSPD31-06

Cardiac Magnetic Resonance Imaging in Pediatric Patient’s ≤ 18 Years with Suspected Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC): A Correlation to Genetics

Wieland Staab MD (Presenter): Nothing to Disclose, Jan Martin Sohns MD: Nothing to Disclose, Martin Fasshauer MD: Nothing to Disclose, Christian Sohns: Nothing to Disclose, Joachim Lotz MD: Research Cooperation, Siemens AG, Christina Unterberg-Buchwald: Nothing to Disclose, Alexander Schwarz: Nothing to Disclose

PURPOSE

This study sought to determine the clinical influence of right and left ventricular findings in pediatric patients undergoing cardiac magnetic resonance imaging (CMRI) ≤ 18 years with suspected arrhythmogenic right ventricular cardiomyopathy (ARVC).

METHOD AND MATERIALS

In a consecutive series between September 2010 and December 2013 (38 months), 79 (14.0 ± 3.9 years, 46

VSPD32-02

Cardiac Magnetic Resonance Imaging in Pediatric Patient’s ≤ 18 Years with Suspected Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC): A Correlation to Genetics

Wieland Staab MD (Presenter): Nothing to Disclose, Jan Martin Sohns MD: Nothing to Disclose, Martin Fasshauer MD: Nothing to Disclose, Christian Sohns: Nothing to Disclose, Joachim Lotz MD: Research Cooperation, Siemens AG, Christina Unterberg-Buchwald: Nothing to Disclose, Alexander Schwarz: Nothing to Disclose

PURPOSE

This study sought to determine the clinical influence of right and left ventricular findings in pediatric patients undergoing cardiac magnetic resonance imaging (CMRI) ≤ 18 years with suspected arrhythmogenic right ventricular cardiomyopathy (ARVC).

METHOD AND MATERIALS

In a consecutive series between September 2010 and December 2013 (38 months), 79 (14.0 ± 3.9 years, 46

VSPD32-03

Cardiac Magnetic Resonance Imaging in Pediatric Patient’s ≤ 18 Years with Suspected Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC): A Correlation to Genetics

Wieland Staab MD (Presenter): Nothing to Disclose, Jan Martin Sohns MD: Nothing to Disclose, Martin Fasshauer MD: Nothing to Disclose, Christian Sohns: Nothing to Disclose, Joachim Lotz MD: Research Cooperation, Siemens AG, Christina Unterberg-Buchwald: Nothing to Disclose, Alexander Schwarz: Nothing to Disclose

PURPOSE

This study sought to determine the clinical influence of right and left ventricular findings in pediatric patients undergoing cardiac magnetic resonance imaging (CMRI) ≤ 18 years with suspected arrhythmogenic right ventricular cardiomyopathy (ARVC).

METHOD AND MATERIALS

In a consecutive series between September 2010 and December 2013 (38 months), 79 (14.0 ± 3.9 years, 46
male) young patients ≤ 18 underwent contrast-enhanced magnetic resonance imaging (CMRI) and genetic analysis after biopsy for evaluation clinically suspected ARVC.

**RESULTS**

Overall, 5 patients showed major criteria due to a combination of moderate to severe RV dysfunction and dilation as well as regional akinesia. Applying the revised TFC, 6 patients showed minor abnormalities such as mild RV dilatation, dys-synchronous RV contraction or regional akinesia. Overall 11 out of 12 (92%) patients with positive genetic characteristics were found to have major or minor abnormalities applying the revised Task Force Criteria. Here, positive predictive value (PPV) was 100%, negative predictive value (NPV) was 93%, sensitivity was 93% and specificity was 100%. Mean RVEDVI/BSA was 80 ± 16 and mean EF was 51 ± 8 in the whole study population. A subgroup analysis revealed a significantly (p = 0.01) decreased mean EF of 36 ± 9 and an increased RVEDVI/BSA of 101 ± 10 in 11 patients with major or minor abnormalities according to the revised TFC.

**CONCLUSION**

This is the first study applying the revised Task Force Criteria (TFC) regarding the detection of ARVC in young patient’s ≤ 18. In the current study, CMRI revealed 11 out of 12 patient’s (major and minor TFC) with positive findings in genetics with perfect positive predictive value and specificity.

**CLINICAL RELEVANCE/APPLICATION**

Applying the revised Task Force Criteria (TFC) regarding the detection of ARVC in young patient’s ≤ 18 may increase the diagnostic value of CMR in this context.

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**VSPD31-07 3D Printing of Complex Intracardiac Morphology**

Shi-Joon Yoo MD (Presenter): Owner, 3D HOPE Medical

**LEARNING OBJECTIVES**

1) Understand 3D printing process for heart models. 2) Know the utility of 3D printing in pediatric cardiac imaging and surgery. 3) Know the limitations of 3D printing technology. 4) Predict the future avenues of 3D printing in pediatric cardiology

**ABSTRACT**

Rapid prototyping or 3D printing is an additive manufacturing technique where the object is digitally decomposed into thin layers and the printer adds the print material layer by layer until a physical model of the whole object is built. The prototype models can be made of solid material like plastic or ceramic, or rubber like material with some resemblance of myocardial texture. Any 3D volume image data can be used for 3D printing. The most ideal is high-resolution isotropic voxel data with ECG-gating and breath-holding or respiration navigation. Breath-held and ECG-gated CT angiograms are most commonly applicable data set.; MR angiograms with ECG-gating and respiration navigation obtained after injection of a blood pool contrast agent provides uniform enhancement of the blood pool with the spatial resolution comparable to CT angiograms. Using 3D image data of contrast angiograms, 3D models of both blood pool and endocardial surface can be manufactured. The blood pool model can be reproduced from contrast-enhanced angiograms by using thresholding technique and manual adjustment. The endocardial surface anatomy can be reproduced by graphically adding a layer outside the blood pool.; When it is printed, the added layer is a shell of the cavity, the inner surface of which represents the endocardial surface anatomy that will be encountered with at operation. The major clinical applications of 3D printing in pediatric cardiology are planning and simulation of surgical procedures for complex congenital heart diseases such as atypical forms of double outlet right ventricle and criss-cross heart. 3D print models are valuable educational resources. This presentation will show a few clinical examples where 3D printing played the major role in surgical decision.

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**VSPD31-08 Percutaneous Drainage Procedures in Children**

John Miras Racadio MD (Presenter): Research Consultant, Koninklijke Philips NV Travel support, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) Review common indications for percutaneous drainage procedures in children. 2) Understand unique differences or special considerations needed in performing percutaneous drainage procedures in children versus adults.

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**VSPD31-09 Palliative Percutaneous Cryoablation in the Pediatric and Young Adult Population**

Brian Faustino Baigorri MD (Presenter): Nothing to Disclose, Peter John Littrup MD: Founder, CryoMedix, LLC Research Grant, Galil Medical Ltd Research Grant, Endo Health Solutions Inc Officer, Delphinus Medical Technologies, Inc, Hussein D. Aoun MD: Nothing to Disclose, Barbara A. Adam MSN: Nothing to Disclose, Mark J. Krycia BS: Nothing to Disclose, Evan N. Fletcher MS, BA: Nothing to Disclose, Matthew Prus BS: Nothing to Disclose, Mohamed M. Jaber MD: Nothing to Disclose

**PURPOSE**

To assess the safety and efficacy of cryoablation for palliation and local tumor control in the pediatric/young adult oncology population.

**METHOD AND MATERIALS**
CT and/or US-guided percutaneous cryoablations were performed using established adult parameters of N+1 cryoprobes for N(cm) tumor diameter. Ablation locations were noted as head and neck, thoracic, liver, kidney, and soft tissue. Tumor type, complications, and length of stay were recorded. Tumors and ablation zones were measured in 3 planes. Complications were graded by the Common Terminology of Complications and Adverse Events (CTCAE v4.0). Patients received CT or MRI follow-up at 1, 3, 6, 12, 18, 24 months and yearly thereafter.

RESULTS

CT and/or US-guided cryoablation was performed on 111 tumors in 36 pediatric and young adults in 82 procedures. All patients received only conscious sedation. An average age of 23 (range 1.6-38) was observed in the pediatric population due to the proportion of young adult sarcoma patients. Benign tumors included 5 osteoid osteoma and 4 desmoids, and the malignant tumors included 32 alveolar soft part sarcomas, 24 renal cell carcinomas, 13 osteosarcomas, 6 synovial sarcomas, and 37 miscellaneous. Tumor ablation location was noted as: 52 thoracic, 11 liver, 12 kidney, and 36 soft tissue. Patient mortality was 0%, with all adverse events being mild/moderate except for two major complications (2.4%). One was due to a bronchopleural fistula following lung ablation of an osteosarcoma metastasis, and the other was due to anticipated facial edema requiring tracheotomy in a head and neck procedure. Local treatment failure or progression occurred in 2.7%(3/111) and satellite recurrence in 6.3%(7/111) of tumors.

CONCLUSION

CT guided percutaneous cryoablation is a safe treatment alternative in the pediatric and young adult population with associated low morbidity, and should be considered in the management of oligoneoplastic disease. Multifocal use of cryoablation is safe for pediatric patients with outcomes similar for adults, also emphasizing its low peri-procedural pain.

CLINICAL RELEVANCE/APPLICATION

Like adults, pediatric oncology patients also suffer from the morbidities of managing localized cancer recurrence or progression. Cryoablation provides for low pain, complication and recurrence rates.

VSPD31-10

CT-guided Placement of Hyperthermia Catheters to Support Regional Deep Hyperthermia for Pediatric Malignancies

Rotem Shlomo Lanzman MD (Presenter): Nothing to Disclose , Rudiger Wessalowski : Nothing to Disclose , Oliver Mils : Nothing to Disclose , Philipp Heusch MD : Nothing to Disclose , Gerald Antoch MD : Nothing to Disclose , Rudiger Wessalowski: Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd , Patric Kroepil MD : Nothing to Disclose

PURPOSE

Percutaneous hyperthermia catheter allow for the placement of Bowman probes for temperature measurements inside the tumor during deep regional hyperthermia treatment. The aim of this study was to evaluate the safety and effectiveness of CT-guided placement of percutaneous hyperthermia catheter in pediatric malignancies.

METHOD AND MATERIALS

Forty pediatric patients (mean age 5.8 ± 5.6 years, range 0-18 years) scheduled for regional deep hyperthermia treatment of germ cell tumors (n=20), rhabdomyosarcoma (n=11), Ewing’s sarcoma (n=3), desmoplastic tumor (n=3), hepatoblastoma (n=1), nephroblastoma (n=1) and lymphoma (n=1) were included in this retrospective analysis. A total of 46 hyperthermia catheters were placed under CT-guidance into tumors in the pelvis (n=29), liver/upper abdomen (n=6), neck (n=3), lower limb (n=5) and vertebral column (n=3). In all patients, the tumor was approached using a 13G puncture sheath under CT-guidance and a 6F percutaneous hyperthermia catheter (Somatex, Medical Technologies) was placed via the sheath inside the tumor. The duration of the intervention, technical success, periinterventional complications and the distance of the probe within the tumor were analyzed.

RESULTS

44 of 46 (95.7%) percutaneous hyperthermia catheters were placed successfully in the tumor. Mean tumor diameter was 4.7 ± 3.5 cm and the mean catheter distance within the tumor was 3.7 ± 3.3 cm. One hyperthermia catheter was placed 8 mm below a rhabdomyosarcoma in the lower limb and one hyperthermia catheter dislocated from a superficial metastasis immediately after the procedure. Mean procedure time was 39.5 ± 16.3 min. No complications were observed.

CONCLUSION

CT-guided hyperthermia catheter placement is a safe and reliable method to support treatment control in deep regional hyperthermia for pediatric malignancies.

CLINICAL RELEVANCE/APPLICATION

Deep regional hyperthermia is a promising salvage treatment option for pediatric malignancies. CT-guidance placement of hyperthermia catheter is a safe and reliable procedure and can therefore be recommended to support temperature measurements inside the tumor during deep regional hyperthermia treatment.

VSPD31-11

First Phase-1 Study in the Treatment of Duchenne Muscular Dystrophy (DMD) by Multiple Intra-Arterial Transplantations of Mesoangioblasts (MABs) in 5 Dystrophic Children: Safety, Preliminary Efficacy, and Future Perspectives
PURPOSE

DMD, a syndrome characterized by progressive absence of dystrophin protein, causes progressive muscle degeneration, paralysis and death. Corticosteroids are not effective, while novel therapies (gene/stem cells) are on work. Our aim was to assess MABs intra-arterial infusion in 5 dystrophic children, at escalating dose, to preliminarily assess the safety.

METHOD AND MATERIALS

After the approval of our institutional ethical committee and obtaining written informed consent from the children's parents, every 2 months 5 DMD children (5 males, mean age=10 years) at a different disease stage under immunosuppressive treatment (tacrolimus) were submitted to 4 HLA-identical allogeneic MABs intra-arterial infusions each (2 in lower limbs, 2 in lower and upper limbs) at escalating dose. Intra-arterial infusions were performed at the level of the common femoral arteries (lower limbs) and the axillary arteries (upper limbs) using a transfemoral approach (4-Fr catheter): arteriography was performed before and after MABs infusion. Efficacy was assessed every 2 months by quantitative strength measurements (Kin-Com-test), thighs/legs fibro-fatty degeneration/quantification (MRI), and after 8 months by gastrocnemius biopsies (dystrophin restoration).

RESULTS

The 20 intra-arterial MABs infusions were regularly performed with no peri-procedural complications, except for a case of iliac vasospasm successfully treated. The only relevant complication was 1 focal thalamic ischemia of 1-cm (MRI) that occurred 5 hours after the fourth infusion in one child, after sporadic atrial fibrillation (ECG) (Atrial-fibrillation-related-thrombosis? Late vasospasm?), without clinical consequences. Relative stabilization/decrease in disease progression was observed in all the children. At MRI, a stabilization of fibro-fatty degeneration was more evident in a child treated at an earlier disease stage, the only that demonstrated a significant dystrophin restoration at Gastrocnemius biopsy.

CONCLUSION

Our preliminary phase 1 study on MABs intra-arterial transplantation in DMD children was relative safe, partially effective with encouraging perspectives. A larger cohort of children and a longer follow up are needed.

CLINICAL RELEVANCE/APPLICATION

A higher MABs intra-arterial concentration, transplanted exclusively in the lower limbs, at an early disease stage, could determine an increase of dystrophin restoration and a consequent improvement of the clinical outcome.

VSPD31-12

Clinical Outcomes in Pediatric Patients Who Underwent Catheter-Directed Portal and Mesenteric Vein Thrombolysis

David L. Lamar, MD, PhD (Presenter): Nothing to Disclose, Giri Shivaram, MD: Nothing to Disclose

PURPOSE

Literature describing transcatheter portomesenteric thrombolysis in pediatric patients is lacking. The purpose of this study is to review our experience with catheter-directed thrombolysis in 8 children with a focus on etiology, presentation, and distribution of portomesenteric vein thrombosis and transcatheter thrombolysis technique, complications, and outcomes.

METHOD AND MATERIALS

Retrospective analysis of 9 cases of catheter-directed portomesenteric vein thrombolysis in 8 patients (6 female, 2 male) performed at a pediatric academic referral-center. Mean age was 15.0 years old (range= 8 to 17 years old) at the time of initial interventions performed between 2005 and 2014. A presumed etiology was determined in 5 of 8 patients and included portal hypertension from various causes (3 patients), splenic torsion, and thrombocytosis following splenectomy for idiopathic thrombocytopenic purpura. No patients had hepatic transplants. For all patients, transhepatic portal access was achieved either via direct percutaneous or transjugular-transhepatic routes. Outcomes examined included resolution of symptoms, degree of lysis, complications, and sustained clot resolution at follow-up.

RESULTS

Successful transcatheter thrombolysis was achieved in 7 of 8 patients; one patient (unknown etiology of thrombus) experienced recurrent thrombus and eventual cavernous transformation. Two patients experienced major bleeding complications requiring transfusion (hemotherax and hemoperitoneum) which were successfully treated percutaneously. Three patients required TIPS shunt placement for portal hypertension at the time of PV thrombolysis or subsequent to initial therapy. No patients died or received hepatic transplants during the follow-up interval (mean= 2.3 years, median= 1.8 years, range= 0.1 to 8.5 years).

CONCLUSION

In our experience, percutaneous transhepatic catheter-directed thrombolysis in children is a safe and effective approach to address portomesenteric thrombosis from a variety of causes.

CLINICAL RELEVANCE/APPLICATION
Use of catheter-directed portomesenteric thrombolysis in children is underreported and our experience suggests this minimally invasive therapy is a safe and effective approach.

**VSPD31-13  Long-term Outcome of Percutaneous Transhepatic Balloon Angioplasty for Portal Vein Stenosis after Pediatric Living Donor Liver Transplantation**

Minoru Yabuta MD (Presenter): Nothing to Disclose, Toshiya Shibata MD: Nothing to Disclose, Rinpei Imamine: Nothing to Disclose, Ken Shinozuka MD: Nothing to Disclose, Hiroyoshi Isoda MD: Nothing to Disclose, Kaori Togashi MD, PhD: 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, Covidien AG

**PURPOSE**

To retrospectively evaluate the long-term outcomes of percutaneous transhepatic balloon angioplasty for portal vein stenosis after pediatric living donor liver transplantation.

**METHOD AND MATERIALS**

Between October 1997 and December 2013, 43 patients (19 boys, 24 girls; mean age, 4.1 years) who had undergone living donor liver transplantation were confirmed to have portal vein stenosis at direct portography with or without manometry, and underwent percutaneous interventions, including balloon angioplasty with or without stent placement. Technical success, patency rates and major complications were evaluated. Follow-up periods after the initial balloon angioplasty ranged from 5 months to 169 months (mean, 119 months).

**RESULTS**

Technical success was achieved in 65 of 66 sessions (98.5%) and in 42 of 43 patients (97.7%). At 1, 3, 5, and 10 years after the first percutaneous transhepatic balloon angioplasty, the rates of primary patency were 83%, 78%, 76% and 70%, respectively, and the rates of primary-assisted patency were 100%, 100%, 100% and 96%, respectively. In major complication, severe asthma attack and portal vein thrombosis subsequent to balloon angioplasty were noted.

**CONCLUSION**

Percutaneous transhepatic balloon angioplasty for portal vein stenosis after pediatric living donor liver transplantation was safe and effective.

**CLINICAL RELEVANCE/APPLICATION**

Percutaneous transhepatic balloon angioplasty might be a safe and effective treatment for portal vein stenosis after pediatric living donor liver transplantation.

**VSPD31-14  Comparison between Radiation Exposures Levels Using an Image Intensifier and A Flat Panel Detector-based System in Image-guided Central Venous Catheter Placement in Pediatric Patients Weighing Less than 10 kg**

Roberto Miraglia MD : Nothing to Disclose, Luigi Maruzzelli MD (Presenter): Nothing to Disclose, Roberta Gerasia : Nothing to Disclose, Simona Maggio : Nothing to Disclose, Angelo Luca MD : Nothing to Disclose

**PURPOSE**

The purpose of this study was a comparison between the radiation exposure levels recorded during CVC placement in pediatric patients weighing less than 10 kg, in procedures performed using an image intensifier-based angiographic system (IIDS) and those performed in a flat panel detector-based interventional suite (FPDS).

**METHOD AND MATERIALS**

A retrospective review of 96 image-guided CVC placements, between January 2008 and October 2013, in 49 pediatric patients weighing less than 10 kg was performed. Mean age was 8.2±4.4 months (range 1 - 22 months). Mean weight was 7.1±2.7 kg (range 2.5 - 9.8 kg). The procedures were classified into 2 categories: non-tunneled and tunneled CVC placement.

**RESULTS**

Thirty-five procedures were performed with the IIDS (21 non-tunneled CVC, 14 tunneled CVC); 61 procedures were performed with the FPDS (47 non-tunneled CVC, 14 tunneled CVC). For non-tunneled CVC mean DAP was 113.5±126.7 cGy·cm² with the IIDS and 15.9±44.6 cGy·cm² with the FPDS (p< 0.001). For tunneled CVC mean DAP was 84.6±81.2 cGy·cm² with the IIDS and 37.1±33.5 cGy·cm² with the FPDS (p=0.02). The statistically significant differences of DAP between the two angiographic systems adjusted for the effect of the fluoroscopy time was confirmed by using a multiple generalized linear regression model. In all procedures image quality was considered adequate by a different interventional radiologist other than the operator with no trade-off between satisfactory image quality and procedural outcome. Technical success was obtained in all procedures without major complications.

**CONCLUSION**
CONCLUSION
The use of flat panel angiographic equipment reduces radiation exposure in small children undergoing image-guided CVC placement.

CLINICAL RELEVANCE/APPLICATION
Our data suggests that the use of flat panel angiographic equipment reduces radiation exposure in small children undergoing image-guided CVC placement and should be considered first line for pediatric interventional radiology procedures. The systematic recording of DAP and fluoroscopy time at the end of every procedure is also an essential step in determining local and/or general radiation exposure reference levels in this particular group of patients.

VSPD31-15 Percutaneous Treatment of Aneurysmal Bone Cysts
William Eugene Shiels DO (Presenter): President, Mauka Medical Corporation Royalties, Mauka Medical Corporation Patent holder, Mauka Medical Corporation

LEARNING OBJECTIVES
1) Identify 2 sites of aneurysmal bone cyst solid tumor localization for large gauge percutaneous core or scrape biopsy yielding diagnostic histologic tissue. 2) Define 3 mechanisms of action for doxycycline foam as a tumor ablation agent targeting aneurysmal bone cyst as a neoplasm. 3) Describe the role of tricalcium phosphate bone graft substitute in the successful treatment of aneurysmal bone cyst.

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and patient outcome were investigated. These factors included diagnostic confidence, stenosis length, and vessel diameter. Image data from 156 patients eligible for evaluation (per protocol population) were assessed by two independent readers in a centralized reading.

RESULTS

No significant differences for gadoterate meglumine and gadobutrol were found comparing both groups in arterial SI (1167+/−930 vs 1243+/−964, p =0.19), SNR (165+/−200 vs 161+/−201, p=0.72) and CNR (159+/−198 vs 155+/−199, p=0.73). Both contrast agents were well tolerated.

CONCLUSION

Contrast media with higher Gd concentration have been proposed to be advantageous as far as efficacy is concerned. However, the present study demonstrated the feasibility of PAOD evaluation at 3T and the lack of superiority of gadobutrol over gadoterate meglumine in terms of diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION

The present study demonstrated the lack of superiority of gadobutrol over gadoterate meglumine in terms of arterial SI, SNR and CNR despite the different Gd-concentrations and T1 relaxivities exhibited by the two contrast agents at 3T in peripheral MRA.

**VSVA31-03**

**Patency of Runoff Detected by MR Angiography at 3.0 T with Cuff-compression: A Predictor of Successful Endovascular Recanalization below the Knee**

**Jungong Zhao MD (Presenter): Nothing to Disclose**

**PURPOSE**

To assess the reliability of distal runoff vessels detected using contrast-enhanced MR angiography (CE-MRA) but were occult on digital subtraction angiography (DSA) for predicting the outcome of endovascular recanalization (ER).

**METHOD AND MATERIALS**

This retrospective analysis included 63 diabetes patients (98 limbs) who underwent ER for below-the-knee infrapopliteal lesions. Before ER, the patients underwent CE-MRA with cuff compression and DSA for arterial disease, their runoff vessels were detected with CE-MRA but not with DSA. The preoperative findings for runoff vessels both on MRA and DSA scans were graded according to the revised version of the ad hoc scoring system. Antegrade intraluminal angioplasty was attempted to recanalize the occlusive lesion; in cases where intraluminal angioplasty failed, subintimal angioplasty as well as retrograde revascularization via the pedal arch loop were performed subsequently. Immediate and follow-up postoperative outcomes were assessed. Univariate analysis was performed to identify the variables associated with successful ER.

**RESULTS**

Successful ER was achieved in 85.7% (84/98) limbs, and the runoff score (5.1 ± 1.1) was significantly smaller than that in the failed limbs (6.2 ± 1.3). Clinical improvement was noted in 85% of the successfully treated limbs. The restenosis and reocclusion rate of the target lesions was 61.1% and 12.6% respectively at 3 months, and 75.9% and 15.6 % respectively at 12 months after ER. The runoff score was associated with a significantly higher likelihood of ER success (odds ratio= 4.096, 95% confidence interval: 2.056, 8.158; P<0.001).

**CONCLUSION**

Runoff vessels detected using CE-MRA could indicate immediate success and better outcome of ER for infrapopliteal occlusions.

**CLINICAL RELEVANCE/APPLICATION**

CE-MRA was superior to DSA in the detection of patent runoff vessels, and potential runoff vessels detected on CE-MRA could be a predictor for immediate success and better outcomes of ER in occluded infrapopliteal vessels. Therefore, the dynamic CE-MRA protocol with high temporal and spatial resolution could be a meaningful adjunct in patients with extensive infrapopliteal lesions.

**VSVA31-04**

**"Novel MR for Peripheral Calcium Score" ; Evaluation of Two New MRI Techniques for Visualization of Peripheral Arterial Calcification; Gradient Echo with Flow Compensation and In-phase Echo Time as Well as 3D PETRA with Ultra-short TE**


**PURPOSE**
To develop a method of visualizing peripheral arterial calcification without using ionizing radiation so that patients with PAC and renal failure may receive adequate evaluation of their peripheral vessels to guide management.

METHOD AND MATERIALS

Following institutional IRB approval, 8 patients (6 male, age 57-78 years, with known peripheral arterial disease on CT angiogram were recruited for a research MRA on a 1.5T system (Avanto, Siemens Technology, Erlangen, Germany). Each underwent (1) gradient echo pulse sequence using flow compensation with in-phase echo time (TE) and (2) 3D pointwise encoding time reduction with radial acquisition (PETRA) with ultra-short TE. Voxel size was 0.52 to 1mm³ Images were assessed for image quality (1-5) and the presence of calcium. Individual calcium plaques were quantitatively assessed for calcium: lumen, calcium: fat and calcium: muscle CNR and SNR.

RESULTS

Both the gradient echo and PETRA sequences each showed all the calcific foci present on CT. The two MRI sequences showed image quality of 4.8 (SD 0.2) and 4.0 (SD 0.0) respectively (p=0.038) and calcium: lumen contrast to noise ratio (CNR) of 46.9 (SD 20.0) and 29.5 (SD 11.6), respectively. (p=0.045).

CONCLUSION

Both Gradient echo pulse sequence using flow compensation with in-phase TE and PETRA are sensitive for the detection of peripheral vascular calcification. The significant calcium: lumen contrast to noise ratio, combined with high spatial resolution can allow radiologists and clinicians to determine the lumen and calcific plaque morphology.

CLINICAL RELEVANCE/APPLICATION

This has significant clinical relevance as many renal patients also have peripheral vascular disease but cannot have contrast enhanced CTA due to contrast induced nephropathy risk. Non-enhanced CT will provide adequate evaluation of the calcium but without luminal evaluation the significance of plaques is limited. Non-enhanced Peripheral MRI, either on its own or combined with nonenhanced peripheral MRA will allow nonenhanced evaluation of both lumen and calcification and provide a growing cohort of vascular patients with satisfactory vascular assessment to guide optimal intervention.

Magnetic Particle Imaging (MPI): Visualization and Quantification of Vascular Stenosis Phantoms


PURPOSE

Purpose of this study was to visualize and quantify different vascular stenosis phantoms using Magnetic Particle Imaging (MPI).

METHOD AND MATERIALS

Nine standardized stenosis-phantoms featuring a circular lumen of 10 mm diameter were used. Their lumen narrowed conically to 1 mm diameter (99% stenosis), 2 mm (96%), 3 mm (91%), 4 mm (84%), 5 mm (75%), 6 mm (64%), 7 mm (51%), 8 mm (36%) or 9mm (19 %), respectively. For MPI, the phantoms were filled with a 1% and 5% dilution of Resovist (Bayer Pharma AG), corresponding to 0.28 and 1.4 mg(Fe)/ml Resovist, respectively. Images were acquired using a pre-clinical MPI-demonstrator (Philips Research, Hamburg, Germany, field of view 36 x 36 x 20 mm³, temporal resolution 46 Volumes per second). Imaging was conducted in steady state without flow and during manual movement of the phantoms through the field of view of the MPI-demonstrator. The MPI-signal was used for image reconstruction and also for intensity measurements to quantify the grade of stenosis. For comparison, the same stenosis-phantoms were evaluated with contrast-enhanced CT. Acquisition time for the 3D CT, MRI, and MPI scans was 1.2 s, 60 s, and 21 ms, respectively.

RESULTS

With a resulting spatial resolution of about 3 x 3 x 1 mm³, MPI was able to visualize all residual lumina of the stenoses accurately except for the highest grade stenosis. It was possible to quantify the extent of the stenoses down to 6 mm (64 %) independently of the Resovist concentration and the rate of movement of the stenosis-phantoms through the field of view. Higher grade stenoses were underestimated, the stenosis of 84% was measured as 74 %, 91 % as 79 %, 96 % as 82 % and 99 % as 88 %. CT exhibited the highest spatial resolution, followed by MRI.

CONCLUSION

Direct quantification of vascular stenoses using MPI is possible in phantoms. Due to the high temporal resolution of the system, visualization and quantification is independent of the movement of the probe, which may be beneficial for future clinical applications where respiratory and cardiac motion occur. With current experimental MPI-systems and available tracer materials, the spatial resolution at high imaging speeds is limited, so that high grade stenoses are underestimated systematically due to a partial volume effect.
CLINICAL RELEVANCE/APPLICATION

Quantification of vascular stenosis using the SPIOs signal intensity may prove beneficial in in vivo cardiovascular imaging using MPI.

VSVA31-06  MR Contrast Agents for Vascular Imaging

Tim Leiner MD, PhD (Presenter): Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Bracco Group

LEARNING OBJECTIVES

1) To understand the different classes of contrast agents available for vascular imaging as well as their strengths and weaknesses. 2) To understand both acute and delayed safety concerns associated with administration of MR contrast agents for vascular imaging. 3) To understand proper contrast agent dosing for vascular MR imaging. 4) To understand basic principles underlying successful contrast injection.

VSVA31-07  Non-contrast MRA: TOF and SSFP Based Techniques

James Christopher Carr MD (Presenter): Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

LEARNING OBJECTIVES

1) Understand the technical issues underlying non contrast MRA based on TOF and SSFP. 2) Become familiar with indications and guidelines for using non contrast MRA. 3) Illustrate applicability of non contrast MRA in a variety of relevant clinical scenarios.

VSVA31-08  18F-FDG PET/MR Carotid Plaque Imaging: Early Experience

Jeffrey M. Lau MD, PhD (Presenter): Nothing to Disclose, Richard Laforest PhD: Nothing to Disclose, Jie Zheng PhD: Nothing to Disclose, Xingyu Nie BS: Nothing to Disclose, Agus Priatna PhD: Research Consultant, Siemens AG Employee, Siemens AG Research Consultant, Siemens AG Employee, Pamela K. Woodard MD: Research support, Siemens AG Research Consultant, Siemens AG Employee, Robert J. Gropler MD: Advisory Board, Brocco Group Advisory Board, GlaxoSmithKline plc Advisory Board, Pfizer Inc Advisory Board, Bayer AG Research grant, GlaxoSmithKline plc Research grant, Pfizer Inc Research grant, Clinical Data, Inc Research grant, Lantheus Medical Imaging, Inc Research support, Astellas Group Consultant, BIOTRONIK GmbH & Co KG, David Duane Faul PhD: Employee, Siemens AG, David Duane Faul PhD: Employee, Siemens AG

PURPOSE

Carotid atherosclerosis is a prevalent disease with significant morbidity and mortality. The current reference standard, carotid ultrasonography, assesses anatomy only, and does not identify whether the lesions are metabolically active. In this pilot study, we investigate the feasibility of carotid atherosclerosis evaluation using simultaneous acquisition Positron Emission Tomography/Magnetic Resonance (PET/MR).

METHOD AND MATERIALS

15 patients undergoing clinical 18F-FDG PET/CT for oncologic purposes were recruited. Carotid PET/MR was performed within 120 mins after 444-703 MBq 18F-FDG injection. Multi-contrast MRI was performed during a 15 minute continuous list-mode acquisition using T1, T2, PD, and gradient-echo (GR) weighted images. The sequences performed were turbo spin-echo (TSE) sequences with an interpolated resolution of 0.25 x 0.25 x 0.8mm. In addition, a SPACE (Sampling Perfection with Application optimized Contrast using different flip angle Evolutions) sequence was used to obtain 3D isotropic (0.8 mm) black blood carotid wall images. PET attenuation correction µ-map was a dual echo VIBE Dixon sequence. PET images were reconstructed with 3D-OSEM (Ordered Subset Estimation Maximization) with 3 iterations, 21 subsets and post-Gaussian filter of 4 mm. Each patient's bilateral common carotid arteries and vertebral arteries were divided into 12 segments for scoring for the presence of plaque, lipid pool, hemorrhage, calcification, and 18F-FDG activity. The method of delineating between fibrous plaque, lipid pool, hemorrhage, thrombus, calcification and other vascular pathologies is based on published differential signal patterns on MR T1, T2, and PD sequences.

RESULTS

29/180 (16%) examined segments showed positive PET activity, 48/180 (26%) showed fibrous plaque, and 16/180 (9%) segments showed lipid pool. Positive PET/MR correlation was seen more frequently with lipid pool (10/16, 63%) versus fibrous (22/48, 46%), suggesting that lipid pool lesions are more likely to be metabolically active than fibrous plaques (z=1.16, P=0.12).

CONCLUSION

We demonstrate that a clinical carotid 18F-FDG PET/MR exam is feasible, quick, and has the potential to provide both anatomic and metabolic information about carotid atherosclerotic plaque.

CLINICAL RELEVANCE/APPLICATION

The complementary PET/MR information may prove significant in patient risk-stratification and assignment of medical or procedural intervention.
Monitoring of Aortic Diameters in Patients with Marfan Syndrome: Intraindividual Comparison of 3D CE-MRA and 2D SSFP Imaging

Simon Veldhoen MD (Presenter): Nothing to Disclose, Cyrus Behzadi: Nothing to Disclose, Thorsten Derlin: Nothing to Disclose, Meike Rybczinsky: Nothing to Disclose, Yskert von Kodolitsch: Nothing to Disclose, Sara Sheikhzadeh: Nothing to Disclose, Frank Oliver Gerhard Henes MD: Nothing to Disclose, Thorsten Alexander Bley MD: Nothing to Disclose, Gerhard B. Adam MD: Nothing to Disclose, Peter Bannas MD: Nothing to Disclose

PURPOSE
Annual imaging of the aortic root is recommended for Marfan patients. Unenhanced MRI allows for avoidance of nephrogenic systemic fibrosis, allergic reactions and contrast paravasation. In this context, we compared non-ECG-gated contrast-enhanced 3D MRA (CE-MRA) and ECG-gated non-contrast 2D steady-state-free precession (SSFP) imaging for monitoring of the aortic diameters in patients with Marfan syndrome (MFS).

METHOD AND MATERIALS
3D CE-MRA and non-contrast 2D SSFP at 1.5T were prospectively performed in 50 patients with confirmed MFS (24 males; age 34.7±13.8). Two readers independently measured aortic diameters at the sinuses of Valsalva, sinutubular junction, ascending aorta, aortic arch and descending aorta. Image quality was assessed on a three-point scale at each level. Aortic root diameters acquired by echocardiography were used as reference standard.

RESULTS
Intra- and interobserver variances of measurements were significantly smaller for 2D SSFP at the sinuses of Valsalva (SSFP, 95% limit of agreement ±0.31cm vs. CE-MRA, ±0.69cm; p=0.002 and SSFP, 95% limit of agreement, ±0.37cm vs. CE-MRA, ±0.59cm; p=0.002) and sinutubular junction (p=0.014 and p=0.043). Image quality was rated significantly better for 2D SSFP than for 3D CE-MRA at sinuses of Valsalva (p<0.0001), sinutubular junction (p<0.0001) and ascending aorta (p=0.02). 3D CE-MRA yielded significantly higher diameters than 2D SSFP measurements at the sinuses of Valsalva (mean bias 0.25cm, p<0.0001), and comparison with echocardiography confirmed a higher bias (0.72±0.34cm) for 3D CE-MRA when compared to 2D SSFP (0.47±0.26cm).

CONCLUSION
ECG-gated non-contrast 2D SSFP imaging provides superior image quality with higher reproducibility and validity due to decreased motion artifacts compared to non-ECG-gated contrast-enhanced 3D imaging. Since 3D CE-MRA overestimates the diameter of the aortic root and requires administration of contrast agents with potential adverse effects, 2D SSFP imaging should be preferred for exact and riskless monitoring of aortic diameters in MFS patients.

CLINICAL RELEVANCE/APPLICATION
ECG-gated non-contrast 2D SSFP imaging should be preferred for monitoring of aortic diameters in Marfan patients.

Non-Enhanced MR Angiography in Critical Limb Ischemia: Comparison of Quiescent-Interval Single-Shot (QISS) and TSE-based Subtraction Techniques to Digital Subtraction Angiography

Mustafa Altaha MBBS (Presenter): Nothing to Disclose, Jeffrey David Jaskolka MD: Nothing to Disclose, Kongteng Tan FRCR: Nothing to Disclose, Manuela Rick: Employee, Siemens AG, Peter Schmitt PhD: Employee, Siemens AG, Ravi Menezes PhD: Nothing to Disclose, Bernd J. Wintersperger MD: Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG

PURPOSE
To evaluate the diagnostic accuracy of non-enhanced prototype Quiescent-Interval Single-Shot (QISS) and conventional TSE-based subtraction Magnetic Resonance Angiography (MRA) in the assessment of the peripheral arteries in patients with critical limb ischemia.

METHOD AND MATERIALS
In this prospective cohort study, patients (n=20; 70% male, 69.7±10.8years) referred for treatment of chronic limb ischemia (Rutherford stages 4-6) underwent non-enhanced QISS and TSE-based subtraction MRA at 1.5T (50%) and image quality on a segmental (n=14) and also regional level (femoropopliteal/tibial/pedal). For statistical analysis results were compared to DSA, both on a segmental and regional level.

RESULTS
22 limbs in 20 patients with 295 segments were available for DSA comparison. QISS image quality was rated as good-excellent in 80% (n=245/308) of segments with no non-diagnostic segments. Sensitivity at the segmental level was 93% (95CI:86-96%) with a specificity of 95% (95CI:91-98%). Positive and negative predictive values were 93% (95CI:88-96%) and 95% (95CI:90-97%), respectively. On a regional level sensitivity was 90% (95CI:78-96%) with a specificity of 60% (95CI:20-90%). After exclusion of pedal segments regional specificity improved to 75% (95CI:24-97%) with no change in segmental/regional sensitivity. Interreader comparison demonstrated fair agreement between readers (K=0.393) for QISS. Motion artifacts affected image quality of the TSE-based technique which was rated non-diagnostic in 65% (n=101/156) and poor in 25% (n=39/156) of segments; no further analysis was performed.
CONCLUSION
QISS MRA demonstrates excellent diagnostic performance in patients with critical limb ischemia, particularly at the femoropopliteal and tibial level. In this patient population, QISS MRA was more robust than TSE-based subtraction MRA, which was affected by patient motion.

CLINICAL RELEVANCE/APPLICATION
The low susceptibility of QISS MRA to patient motion provides stable diagnostic information in challenging patients with critical limb ischemia and contra-indication to Gd-based contrast agents.

3D-Black-Blood 3T-MRI for the Diagnosis of Thoracic Large Vessel Vasculitis: A Feasibility Study
Tobias Saam MD (Presenter): Research Grant, Diamed Medizintechnik GmbH Research Grant, Bayer AG, Stefan Maurus: Nothing to Disclose, Nora Navina Kammer MD: Nothing to Disclose, Karla Maria Treitl MD: Nothing to Disclose, Hendrik Kooijman: Employee, Koninklijke Philips NV, Eva Maria Coppenrath MD: Nothing to Disclose

PURPOSE
Although 2D-T1w black-blood sequences are able to detect atherosclerotic and inflammatory changes of thoracic vessels they are time extensive and thus offer limited coverage. We sought to evaluate a commercially not available isotropic 3D black-blood T1w-TSE sequence with variable flip angles (3D-T1-BB-VISTA) for the diagnosis of thoracic large vessel vasculitis.

METHOD AND MATERIALS
14 patients with suspected large vessel vasculitis and 14 control patients without any evidence of vascular disease received a standardized protocol with a fat suppressed 3D-T1-BB-VISTA pre- and post contrast (resolution=0.8 mm³ isotropic, scan time 5-6 minutes) using a navigator and peripheral pulse unit triggering. Ascending and descending aorta, aortic arch, left and right subclavian arteries and pulmonary arteries (168 arterial segments) were evaluated by two experienced readers in consensus decision for the presence of concentric wall thickening and contrast enhancement of the vessel wall.

RESULTS
Acceptable image quality was achieved in 27 out of 28 exams (96.4%). 35 out of 84 (41.7%) arterial segments in patients with suspected vasculitis showed contrast enhancement and 27 out of 84 (32.1%) concentric wall thickening. Both findings were found in 8 distinct patients with clinically confirmed vasculitis. Only one out of 78 (1.3%) arterial segments of the control group showed concentric wall thickening and contrast enhancement. In 2 out of 14 patients with suspected vasculitis effusion and synovialitis were found in the shoulder joints, suggestive of polymyalgia rheumatica. Figure 1 shows images of a 76-year-old male (#1) with giant cell arteritis and inflammatory activity in both subclavian arteries and synovialitis in the right shoulder and of a 28 year-old female (#2) with Takayasu arteritis and inflammatory activity in both pulmonary arteries.

CONCLUSION
Free breathing navigated black-blood MRI is feasible in less than 12 minutes scan time and allows to accurately diagnosing thoracic vasculitis. Future studies will be necessary to evaluate the utility of this sequence for monitoring of anti-inflammatory therapies.

CLINICAL RELEVANCE/APPLICATION
Currently PET/CT is used as gold standard to diagnosing vasculitis of the aorta and the pulmonary arteries. Black-blood MRI has the potential to replace PET/CT as a diagnostic tool. This might be particularly useful in young patients in which ionizing radiation should be used with caution.

Hemodynamic Changes in the Thoracic Aorta Due to Surgery on Ascending Thoracic Aortic Aneurysms using 4D Flow MRI
Maximilian Russe MD (Presenter): Nothing to Disclose, Fabian A. Kari: Nothing to Disclose, Nadja Maria Kocher: Nothing to Disclose, Benjamin Fritz MD: Nothing to Disclose, Gregor Pache MD: Nothing to Disclose, Mathias F. J. Langer MD, PhD: Nothing to Disclose

PURPOSE
Evaluation of 4D flow MRI to detect alterations in flow parameters in a postoperative setting after ascending aortic aneurysm and/or aortic root repair.

METHOD AND MATERIALS
4D flow MRI was performed at 3T MR systems for a prospective study of 12 patients (age 56±13 years) before surgery and of 5 patients within 10 days after surgery. Flow quantification was performed using ECG gated three-directional velocity encoding with full 3D coverage of the thoracic aorta. 4D flow MRI was acquired in a sagittal oblique 3D volume using flip angle of 8°, VENC: 150 cm/s, spatial resolution = (2.0-2.4)³mm³, and temporal resolution: 20-40 ms. Data analysis included 3D blood flow visualization (EnSight, CEI, USA) based on 3D particle traces and 3D streamlines. Time-resolved 2D data was extracted on a plane based queries in the ascending thoracic aorta (TAA) in the aneurysm and the postoperative aortic graft for each dataset. The
diameter, net flow, velocity, time to peak (TTP) and percentage of retrograde flow were derived.

RESULTS
Following changes were shown between the preoperative ascending aorta and the postoperative graft. Slight increase in net flow (TAA: 65.2 (±13.9) ml; graft: 76.5 (±14.7) ml; +17%; p-value=0.5). Increase in mean velocity (TAA: 4.43 (±1.73) cm/s; graft: 19.4 (±2.25) cm/s; +339%; p-value=0.05). Decrease in percentage of retrograde flow (TAA: 19.1 (±13.3)%; graft: 3.6 (±2.2)%; -81% p-value<0.05). Slight decrease in TTP (TAA: 155 (±65) ms; graft: 111 (±14) ms; -28%; p-value=0.18). The mean internal diameter was measured in the TAA with 48.1 (±4.7) mm and in the graft with 29.7 (±2.8) mm (-38%, p<0.05).

CONCLUSION
These preliminary results revealed quantifiable hemodynamic changes after surgery for ascending thoracic aortic aneurysms. Significant changes of velocity and retrograde were observed. Only small changes on net flow and TTP could be demonstrated. Further studies are warranted to investigate the influence of the aortic repair on the whole thoracic aorta and evaluate these parameters as a method for early prediction of long time outcome after aortic repair.

CLINICAL RELEVANCE/APPLICATION
These findings in flow parameters after surgery for ascending thoracic aortic aneurysms are additional quantifiable parameters for the evaluation of the postoperative result.

VSVA31-13 Assessment of Blood Flow Patterns in Infrarenal Abdominal Aortic Aneurysms— An Approach using 4D Flow MRI

Maximilian Russe MD (Presenter): Nothing to Disclose, Philipp Blanke MD: Nothing to Disclose, Benjamin Fritz MD: Nothing to Disclose, Gregor Pache MD: Nothing to Disclose, Wulf Euringer: Nothing to Disclose, Mathias F. J. Langer MD, PhD: Nothing to Disclose

PURPOSE
Evaluation of alterations in flow pattern in the infrarenal aortic aneurysm using 4D flow MRI.

METHOD AND MATERIALS
4D flow MRI was performed at 3T MR systems for a prospective study of eight male patients (age 70±9 years) with infrarenal aortic aneurysms. Flow quantification was performed using ECG gated three-directional velocity encoding with full 3D coverage of the abdominal aorta. 4D flow MRI was acquired in a coronal oblique 3D volume using flip angle of 15°, VENC: 80 cm/s, spatial resolution = (1.0-2.7)³mm³, and temporal resolution: 39-42 ms. Data analysis included 3D blood flow visualization (EnSight, CEI, USA) based on 3D particle traces and 3D streamlines. Time-resolved 2D data was extracted on plane based queries in the suprarenal abdominal aorta and in the AAA for each dataset; flow and wall parameters were derived: diameter, velocity, percentage of retrograde flow, wall shear stress (WSS) and oscillatory shear index (OSI).

RESULTS
Following changes were revealed between the abdominal aorta and the AAA. Decrease in mean velocity (aorta: 8.89 (±4.31) cm/s; AAA: 1.30 (±1.50) cm/s; -85%; p-value<0.01) Increase in percentage of retrograde flow (aorta: 8.1 (±13.2)%; AAA: 24.1 (±15.7)%; +197% p-value<0.01). Decrease in mean WSS (aorta: 116.2 (±46.5) mN/m²; AAA: 23.6 (±15.7) mN/m²; -80% p-value< 0.01) and increase in OSI (aorta: 7.2(± 4.0); AAA: 14.2(±8.4); +96%; p-value=0.13). The mean diameter was measured in the aorta with 21.4 (± 1.4) mm and in the AAA with 39.3 (± 8.9) mm (+84%, p<0.01).

CONCLUSION
4D flow MRI demonstrates significant quantifiable hemodynamic changes in the infrarenal aortic aneurysm compared to the non-dilated suprarenal aorta. There is a decrease in mean velocity and an increase in percentage of retrograde flow, WSS and OSI. Follow-up studies are warranted to investigate the influence of these findings on progress of the aneurysm and patient outcome.

CLINICAL RELEVANCE/APPLICATION
These findings in wall and flow parameters are additional quantifiable parameters in the abdominal aneurysms and may help for risk stratification and further therapy planning.

VSVA31-14 Non-contrast MRA: Phase-contrast MRA
Scott Brian Reeder MD, PhD (Presenter): Institutional research support, General Electric Company Institutional research support, Bracco Group

LEARNING OBJECTIVES
1) Understand the underlying principles of phase velocity MRA. 2) Be familiar with the currently available methods for phase velocity MRA. 3) Be familiar with important applications and examples of phase velocity MRA. 4) Understand current limitations and pitfalls associated with phase velocity MRA.

ABSTRACT
1. Understand the underlying principles of phase velocity MRA
2. Be familiar with the currently available methods for phase velocity MRA
3. Be familiar with important applications and examples of phase velocity MRA
4. Understand current limitations and pitfalls associated with phase velocity MRA

**Business Session**

**Miscellaneous**

_Tue, Dec 2 10:00 AM - 10:20 AM Location: S403B_

**ABSTRACT**

According to Section 8.10 of the RSNA Bylaws, the Society shall hold at least one business meeting of the members of the Society in each calendar year. At the sessions of the business meeting on Sunday, November 30, and Tuesday, December 2, awards are announced; nominations and elections are held; and proposed amendments to the Bylaws are considered. A third session is scheduled on Thursday, December 4, if necessary.

**Hologic: Low-dose 3D Mammography for Breast Cancer Screening.**

Vendor Workshops

_Tue, Dec 2 10:15 AM - 11:45 AM 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. Please visit [www.hologic.com/RSNAtomo-courses](http://www.hologic.com/RSNAtomo-courses) to register for this Vendor Workshop.

**Hologic: Essentials of 3D Mammography Self-Guided Training**

Vendor Workshops

_Tue, Dec 2 10:30 AM - 12:30 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.

**GE Healthcare: GE Healthcare Breast Health Advantage: 3D Automated Breast Ultrasound (ABUS): An Interactive Hands on Workshop**

Vendor Workshops

_Tue, Dec 2 10:30 AM - 11:00 AM 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


**MSAS32**

**Imaging Updates–New Technology Practices (Sponsored by the Associated Sciences Consortium) (An Interactive Session)**

_Multisession Courses_
Participants

Moderator
Steven P. DeColle: Nothing to Disclose

Moderator
Cindy R. Comeau BS, RT: Nothing to Disclose

Sub-Events

**MSAS32A**  
Trends in Hybrid Imaging PET/MR

David Walter Jordan PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the main features, advantages of simultaneous PET-MRI scanners.
2) Describe the main features, advantages of sequential PET-MRI scanners.
3) Describe current clinical uses of PET-MRI.
4) Describe future PET-MRI applications that are currently under investigation.

**MSAS32B**  
MRI Safety—Facing the Challenges-PET/MR

Karen E Smith Msc (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify the safety challenges of PET/MRI from both a technologist and patient perspective.
2) Describe the technical challenges of PET/MRI compared to PET/CT.
3) Recognize various potential workflow considerations and challenges in PET/MRI.
4) Analyze the difficulties with the implementation of PET/MRI and ways to overcome these.

**MSAS32C**  
Everyone on Board: Creating an Opportunity for Flat Collaboration and Safe Collegiate Working in Molecular Imaging

Marc Griffiths Msc (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Determine the key health and safety issues for a Nuclear Medicine Technologist working in a PET/MRI unit.
2) Explore how a multi-professional approach to delivering patient care may arise from working within a hybrid imaging environment.
3) What are the opportunities and challenges associated with introducing new automated software platforms within a hybrid imaging environment.
4) What could you learn, in terms of counselling skills, from your nursing colleagues, which may benefit oncology patients within a hybrid imaging environment.

**MSCC32**

Case-based Review of Nuclear Medicine: PET/CT Workshop—Cancers of the Thorax (In Conjunction with SNMMI) (An Interactive Session)

**Multisession Courses**

**LEARNING OBJECTIVES**

1) Apply basic anatomic, pathologic, and physiologic principles to the interpretation of PET/CT with emphasis on cancers of the thorax.
2) Identify artifacts that can influence interpretation of PET/CT studies and analyze factors that can improve image quality while minimizing patient risk.
3) Demonstrate understanding of issues on current and future practice patterns.

**MSES32**

Essentials of Cardiac Imaging

**Multisession Courses**
Sub-Events

MSES32A  Cardiac Devices: Appearance on Imaging
Karin Evelyn Dill MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Learn the indications for cardiac support devices used in current clinical practice. 2) Understand the surgical placement of cardiac devices in order to determine appropriate positioning by imaging. 3) Recognize abnormalities of cardiac devices.

ABSTRACT

There are many cardiac support devices currently in use. As radiologists, it is imperative that we are familiar with the indications, appropriate placement and positions of such devices. Working as part of a multidisciplinary team, we are the front line imagers of these devices, often the first physicians to view the patient by imaging after device placement. Therefore, it is our responsibility to accurately interpret the images and confidently communicate abnormalities with referring clinicians. This presentation will review the most common cardiac devices in clinical use and their appropriate appearances on imaging.

MSES32B  Evaluation of Adult Congenital Heart Disease with CT
Satinder Pal Singh MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss the expanding role of MDCT in evaluation of adult CHD with several illustrative cases. CT provides excellent anatomic information about intra and extra cardiac anomalies and any complications related to palliative or corrective surgery done in early childhood. Retrospective gated CT is also helpful in evaluation of right ventricle function especially in the presence of hardware.

ABSTRACT

Advances in surgical technique and perioperative care have significantly improved the success rate and life expectancy in congenital heart disease (CHD). Echocardiography remains the primary imaging method though it can be limited by lack of adequate acoustic windows and suboptimal depiction of the extra cardiac vasculature, which can be important in the postoperative evaluation. Multidetector computed tomography (MDCT), because of wide availability, short acquisition time, high spatial resolution, improved temporal resolution and isotropic imaging, is an attractive alternative method. The radiation exposure from CT can be limited by choosing appropriate protocol based on the clinical question and use of lower kVp, mAs, iterative reconstruction, high pitch imaging and limiting FOV to the desired anatomy. MDCT is playing an increasingly important role in the postoperative imaging and surveillance of patients with congenital heart disease with its unique capabilities to characterize anomalies and complications that may be difficult to evaluate with other technique. CT provides objective and accurate morphologic and functional information and is very useful for detecting extracardiac abnormalities. When performed with ECG-gating, CT provides useful information about coronary arteries, valves, complex cardiac morphology, and cardiac function, especially in patients with previous surgery, the details of which are unknown. A thorough understanding of the normal anatomy, morphologic features of congenital heart diseases, knowledge of the details of surgical procedures and their complications are essential for choosing optimal CT protocol and accurate CT interpretation. A sequential segmental approach should be used in evaluating morphologic features, during the review of CT images obtained in patients with congenital cardiac defects and in postoperative adult patients.

MSES32C  Myocardial Perfusion in Clinical Care
Matthijs Oudkerk MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the clinical relevance of myocardial perfusion in terms of diagnosis and prognosis. 2) Compare the differences between test characteristics of the applied imaging modalities. 3) Identify and tailor the pre-test probability of the patient population to the imaging modality. 4) Interpret the diagnostic validity of the test outcome per imaging modality.

ABSTRACT

Contrary to coronary angiography, FFR or CCTA, myocardial perfusion imaging (MPI) is the only method to demonstrate myocardial ischemia. It reflects the final result of the effects of coronary flow impairment due to stenosis or obstruction together with compensatory flow through communicating coronary vessels and flow through collaterals. Therefore it is the ultimate proof for haemodynamically relevant coronary flow impairment. While different modalities for MPI have different diagnostic accuracy, the overall accuracy to diagnose hemodynamically significant coronary artery disease (CAD) is good. Analysis of MPI results in clinical setting is mostly performed by visual evaluation of presence and pattern of hypothenancement of the myocardium during
first pass of intravenously injected contrast or tracer. This method relies on the existence of regions with normal perfusion as reference, which limits its accuracy in cases of multi-vessel disease or balanced ischemia. Quantitative methods capable of solving this limitation were first established in PET, where time-resolved acquisition of the first-pass of tracer uptake and direct quantification of tracer concentration from PET attenuation were developed. With these characteristics, tracer kinetic modeling can be applied to produce independent quantitative estimates of perfusion in stress and rest, known as absolute perfusion measures or biomarkers. The added clinical value of PET over relative and visual perfusion analysis has been demonstrated. With recent technological advances in MRI and CT imaging, these techniques are receiving increased attention for evaluation of myocardial perfusion biomarkers. State-of-the-art MRI and CT have better spatial and temporal resolution compared to PET. MRI and CT also have wider possibilities for integration into current clinical workup for CAD due to their wider availability and increasing clinical role in comprehensive diagnosis of CAD.

URL's

www.cmi-nen.nl

MSQI32

Radiologist Performance Improvement: Implementing Lean in Your Practice

Multisession Courses

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

Tue, Dec 2 10:30 AM - 12:00 PM  Location: S406B

 Participants

Moderator
James Vincent Rawson MD : Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss implementation strategies of Lean and Change Management. 2) Discuss Alignment of Operations and Outcomes. 3) Discuss Role of Employee Engagement in Change. (This course is part of the Quality Improvement Symposium)

ABSTRACT

Lean techniques are being used in healthcare with increased frequency. This program will focus on how Lean can be started and implemented in a healthcare environment. The role of process redesign in strategy and operations will be discussed.

Sub-Events

MSQI32A  Linking Vision, Strategy, Operations and Outcomes
Karl N. Krecke MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title. (This course is part of the Quality Improvement Symposium)

MSQI32B  Resources, Training and Teaching LEAN in Radiology
James Vincent Rawson MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title. (This course is part of the Quality Improvement Symposium)

MSQI32C  Lean Change Management and Engaging Employees
Joseph R. Steele MD (Presenter): Consultant, INTIO, Inc Stockholder, INTIO, Inc Stockholder, Intelliject, Inc Stockholder, MedicaSafe, Inc Consultant, Adient Medical Inc Stockholder, Adient Medical Inc Consultant, Edumedics LLC Stockholder, Edumedics LLC

LEARNING OBJECTIVES

View learning objectives under main course title. (This course is part of the Quality Improvement Symposium)

MSRO32

BOOST: Head and Neck—Integrated Science and Practice (ISP) Session
Multisession Courses

AMR PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 10:30 AM - 12:00 PM   Location: S103AB

Sub-Events

MSRO32-01 Invited Speaker:

MSRO32-02 Radiotherapy-Treated Early Glottic Cancers: 15-Year Regional Cancer Center Experience
Jennifer  Kwan  BS (Presenter): Nothing to Disclose, Wilma M Hopman  MA : Nothing to Disclose, Steve  Hall  MD, MSc : Nothing to Disclose, Timothy E Owen  MD,FRCP : Nothing to Disclose, Khaled Osman  Zaza  MD, FRCP : Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Accurate staging is the most important factor guiding the management of patients with localized glottic cancers. To date, CT has served as the primary imaging modality used for staging of laryngeal cancers, but it is known that MRI has a higher sensitivity to detect cartilage invasion. It is hypothesized that use of MRI provides improved staging accuracy and better outcomes for early glottic cancers. This study reports our 15-year regional cancer center outcomes of treatment for T1-2N0 glottic cancers. Findings reflect our unique experience with early adoption of MRI for tumor staging, which began in the 1990s. In addition, based on the poorer outcomes of patients of low-socioeconomic status described in literature, it was hypothesized that these patients may have a different set of prognostic factors than the general population. Our cancer center serves a large proportion of rural and low-income residents; this allowed for the identification of relevant prognostic factors for this population.

Materials/Methods: Medical records of 64 patients with T1-2N0 glottic cancers, treated from 1997-2012 at our institution, were retrospectively reviewed for patient, tumor, and treatment characteristics. Univariate analyses were performed and Kaplan-Meier curves were generated for 5-year disease-free (DFS), laryngectomy-free (LFS), disease-specific (DSS), cancer-specific (CSS), and overall (OS) survivals. National Cancer Institute definitions of survival outcomes were used.

Results: 59 patients received radiation and 5 received surgery as definitive treatment for T1-2N0 glottic cancers. Of the 59 patients who received radiation, 13 (22.0%) had a local recurrence of cancer, which was treated in 9 cases with total laryngectomy, 2 with hemilaryngectomy, 1 with hemicoarctectomy, and 1 case was not operated on. The median time to recurrence was 12.3 months. 5-year DFS, LFS, DSS, CSS, and OS were 79.7%, 84.7%, 94.9%, 84.7%, and 79.7% respectively for radiation-treated cancers. Patients treated with upfront surgery had comparable outcomes with 5-year DFS, DSS, CSS, and OS of 75.0%, 100.0%, 100.0%, and 75.0% respectively. On univariate analysis, top factors relating to poor overall survival from radiation included supraglottic extension (p=0.01), use of feeding tube (p=0.02), and higher T stage (p=0.05).

Conclusion: This study describes optimal survival outcomes for patients with T1-2N0 glottic cancers that parallel or surpass CT-staged outcomes described in literature, despite the rural and low-income backgrounds of the study population. Results suggest that use of MR imaging to stage laryngeal cancers may be beneficial for achieving accurate staging and improved survival outcomes. Prognostic factors have also been identified for this unique patient population.

MSRO32-03 A Randomized Phase III Study of Adverse Events between Sequential (SEQ) versus Simultaneous Integrated Boost (SIB) Intensity Modulated Radiation Therapy (IMRT) in Nasopharyngeal Carcinoma; Preliminary Result
Anussara  Songthong  MD (Presenter): Nothing to Disclose, Danita  Kannarunimit  MD : Nothing to Disclose, Chakkapong  Chakkabat  MD : Nothing to Disclose, Chawalit  Lertbutsayanukul  MD : Nothing to Disclose

PURPOSE
Simultaneous integrated boost intensity modulated radiation therapy (SIB-IMRT) is widely used in treatment of nasopharyngeal carcinoma (NPC). Higher dose per fraction leads to increased tumor control probability despite higher risk of normal tissue complications. The purpose of this study is to investigate acute and late toxicities comparing SEQ-IMRT versus SIB-IMRT in patient with NPC.

METHOD AND MATERIALS
Newly diagnosed stage IJV NPC patients were stratified and randomized to receive SEQ-IMRT or SIB-IMRT. SEQ-IMRT consisted of two sequential radiation treatment plans; 2Gy x 25 fractions to low-risk planning target volume (PTV-LR) followed by 2Gy x 10 fractions to high-risk planning target volume (PTV-HR). In contrast, SIB-IMRT consisted of only one treatment plan; 2.12Gy and 1.7Gy x 33 fractions to PTV-LR and PTV-HR, respectively. All patients received concurrent weekly cisplatin followed by three cycles of adjuvant cisplatin and...
For this analysis. Factors analyzed included demographics, imaging and pathologic data, treatment with
standard treatment for oral cavity squamous cell carcinoma (OCSCC) is surgical resection followed by
adjuvant therapy based on pathologic analysis. Pre-operative imaging has been used to determine nodal involvement
and has guided determination of the need for a neck dissection (ND). We sought to evaluate the patterns of
disease while 20% and 76% of patients had stage III and IV disease, respectively. The majority of patients
had laryngeal (40%) and oropharyngeal (20%) cancer, while remaining patients had oral cavity, hypopharynx,
paranasal sinus, salivary, and unknown primary cancers. The median prescription dose was 66.0 Gy (60.0-70.4 Gy)
delivered in 30 fractions (30-35 fractions). High-risk tumor volumes received a median dose of 2.12 Gy (2.00-2.25 Gy) per fraction while the low-risk volumes received a median dose of 1.80 Gy (1.64-2.00 Gy) per fraction. The 1/2/4-year LC, OS, and distant metastasis-free survival rates were 95.0/95.0/88.0%, respectively (p =0.406 for OS and 0.053 for PFS).

CONCLUSION
This randomized phase III trial comparing SIB-IMRT versus SEQ-IMRT in NPC showed no statistically significant
difference between both IMRT techniques in terms of acute and late adverse events. Short-term tumor control
and survival outcome were promising.

CLINICAL RELEVANCE/APPLICATION
SIB-IMRT (dose painting technique) resulted in similar adverse events compared with SEQ-IMRT (shrinking field
technique) in NPC.

Purpose/Objectives:
Despite aggressive post-operative radiotherapy with or without chemotherapy for advanced head and neck
cancer, locoregional recurrence rates remain suboptimal. With respect to radiation treatment, patients are
generally treated with sequential planning radiation treatment in which the same dose is delivered to shrinking
tumor volumes. Accelerated hypofractionated schedules with the simultaneously integrated boost-intensity
modulated radiation therapy (SIB-IMRT) technique have gained increased interest in hopes of obviating tumor
repopulation. This study aimed to assess toxicities and outcomes in patients with head and neck cancer treated
with SIB-IMRT post-operatively at a single institution.

Materials/Methods:
Between 2003 and 2012, 25 patients (21 males, mean age 57) with head and neck cancer were treated with post-
operative SIB-IMRT at a single institution. Seventeen patients (68%) received chemotherapy. The median
KPS at the time of treatment was 80 (80-100). Toxicities were recorded according to the Common Terminology
Criteria for Adverse Events Version 4.0. Kaplan-Meier survival analyses were used to estimate local control (LC)
and overall survival (OS) rates. The multivariate Cox regression method was used to model predictors of
outcome.

Results:
The median follow-up after SIB-IMRT was 36 months (7-112 months). Four percent of patients had stage II
disease while 20% and 76% of patients had stage III and IV disease, respectively. The majority of patients
had laryngeal (40%) and oropharyngeal (20%) cancer, while remaining patients had oral cavity, hypopharynx,
paranasal sinus, salivary, and unknown primary cancers. The median prescription dose was 66.0 Gy (60.0-70.4 Gy)
delivered in 30 fractions (30-35 fractions). High-risk tumor volumes received a median dose of 2.12 Gy
(2.00-2.25 Gy) per fraction while the low-risk volumes received a median dose of 1.80 Gy (1.64-2.00 Gy) per fraction. The 1/2/4-year LC, OS, and distant metastasis-free survival rates were 95.8/85.1/71.4%, 91.0/81.3/75.1%, and 95.0/95.0/88.0%, respectively. Five patients (20%) experienced acute grade 3 toxicity and one patient (4%) had late grade 3 toxicities. No acute or late grade 4 toxicity was reported. On univariate analysis, no risk factors were identified as significant predictors of local failure or OS.

Conclusion:
Post-operative SIB-IMRT is an effective and safe technique in the treatment of patients with head and neck
cancer with or without concurrent chemotherapy. Our results with respect to outcome and toxicity are
comparable to those obtained with conventional radiotherapy. For select patients, SIB-IMRT is a reasonable
alternative strategy with potential clinical and operational advantages.

The Role of PET/CT in the Nodal Management of Squamous Cell Carcinoma of the Oral Cavity
Jennifer Lobo Shah MD (Presenter): Nothing to Disclose, Wendy Hara MD : Nothing to Disclose

PURPOSE
Standard treatment for oral cavity squamous cell carcinoma (OCSCC) is surgical resection followed by adjuvant
therapy based on pathologic analysis. Pre-operative imaging has been used to determine nodal involvement
and has guided determination of the need for a neck dissection (ND). We sought to evaluate the patterns of
failure when a ND was omitted due to pre-operative PET/CT showing no nodal involvement.

METHOD AND MATERIALS
From 2003-2013, we treated 761 patients with OCSCC. A pre-operative PET/CT was performed for 333 patients,
of which 260 were retrospectively reviewed. ND was omitted in 41 of these patients, which comprised the cohort
for this analysis. Factors analyzed included demographics, imaging and pathologic data, treatment with

RESULTS
Between October 2010 and November 2013, 130 eligible patients were randomized between SEQ-IMRT (59
patients) and SIB-IMRT (71 patients). Dosimetric data showed significant difference in PTV-LR dose as well as
median one parotid gland dose. With median follow-up time of 460 days (17-1211 days), there was no
significant difference in toxicities between both IMRT techniques. During chemoradiation, the most common
gs were mucositis (14% vs 13.2% SEQ vs SIB, p=0.897) followed by dysphagia (6.8% vs 10.3%, p=0.774) and xerostomia (8.8% vs 7.4%, p=0.512). During adjuvant chemotherapy period, 23.8% and 34.6% experienced grade 3 weight loss in SEQ-IMRT and SIB-IMRT (p=0.255). At 1 year, grade 3 weight loss was not significantly different between two arms. One-year overall survival (OS) and progression-free survival (PFS) were 93.9% and 98% in SEQ-IMRT and 98% and 88.8% in SIB-IMRT, respectively (p =0.406 for OS and 0.053 for PFS).
RESULTS
Median follow-up was 37 months. Subsites included: 59% oral tongue, 22% alveolar ridge, 15% floor of mouth, 2% lip, 2% buccal mucosa, 2% retromolar trigone, and 0% hard palate. 41% were T1, 39% were T2, 12% were T3, and 7% were T4. ND was omitted due to a node-negative (NN) PET/CT in 44% or due to perineural invasion (PNI) seen at biopsy indicating a need for adjuvant RT in 29%. Other reasons included co-morbidities and the potential for complications. 46% of patients received adjuvant RT. At median follow-up, OS was 80%, LR was 20%, and RR was 22%. LR was associated with tumor size >2.5 cm (p=0.02) and close margins (p=0.06). Decreased OS was associated with tumor size >2.5 cm (p=0.01), close margins (p=0.06), and node-positive (NP) PET/CT (p=0.01). Of the 12 patients who had a NP PET/CT, the reason for ND omission was PNI in 6 patients, early stage disease in 1 patient, potential complications in 3 patients, and unclear reasons in 2 patients. 33% of the RRs occurred in patients with a NP PET/CT.

CONCLUSION
This data shows a significant risk of RR in patients with OCSCC with ND omission on the basis of a NN PET/CT. Furthermore, decreased OS was seen in patients with a NP PET/CT with ND omission on the basis of meeting pathologic indications for adjuvant RT. This suggests that ND may play an important therapeutic role in the management of patients with OCSCC irrespective of PET/CT findings.

CLINICAL RELEVANCE/APPLICATION
PET/CT should be used with caution when determining the need for neck dissection in OCSCC.

MSRO32-06  
Prediction Response to Intensity-Modulated Radiotherapy of Nasopharyngeal Carcinoma: A Dynamic Contrast-Enhanced MR Imaging Study at 3T

Dechun Zheng (Presenter): Nothing to Disclose, Chen Yunbin MD: Nothing to Disclose, Xiangyi Liu BS: Nothing to Disclose, Weibo Chen PhD: Nothing to Disclose, Queenie Chan PhD: Nothing to Disclose, Chaobin Huang: Nothing to Disclose, youping xiao: Nothing to Disclose, Wang Ren: Nothing to Disclose, Jianji Pan: Nothing to Disclose

PURPOSE
To prospectively evaluate dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) as a tool for assessing short-term control of chemoradiotherapy (CRT) in nasopharyngeal carcinoma (NPC).

METHOD AND MATERIALS
Fifty patients with local advanced NPC scheduled for neoadjuvant chemotherapy (NAC) following intensity-modulated radiation therapy (IMRT) were studied. DCE-MRI was performed within one week before NAC and repeated one week after IMRT treatment using a 3T clinical scanner system (Achieva TX, Philips Healthcare). Clinical response was evaluated after completed CRT according to the RECIST criteria. Four kinetic parameters (Ktrans, Kep, ve and vp) were measured based on extended Tofts' Model and compared to different clinical response groups using student T or Mann-Whitney U test.

RESULTS
Ktrans and Kep values were reduced after one week IMRT in patients with clinical treatment response after NAC and CRT treatment. The pretreatment Ktrans value, percentage change and difference values of Ktrans and Kep (Ktrans(Perc) and Kep(Perc), ΔKtrans and ΔKep) between pretreatment and after one week IMRT, and tumor regression after one week IMRT were all significantly larger in complete response (CR) patients than those with residual disease (partial response, PR) after radical CRT (Table 1, P < 0.05). We found out in boxplot analysis that ΔKtrans, Ktrans(Perc) and Kep(Perc) metrics were predictive imaging markers for response assessment of NPC subjects who treated with CRT, which demonstrated that patients who were CR after CRT clustered in separate regions from those were PR (Figure 1). The receiver operating characteristic (ROC, Figure 2) analyses proved that diagnosis efficacies of single Ktrans, ΔKtrans, ΔKep, Ktrans(Perc) and Kep(Perc) values ranging from 71.8 - 87.0%. And combined with tumor shrink ratio with above parameters yielded the highest diagnosis efficacy (90.2%) as well as the highest sensitivity (92.3%) and specificity (81.1%), respectively.

CONCLUSION
DCE-MRI has the potential to predict short-term control of locally advanced NPC by mean of earlier evaluating changes of tumor vascularization and volume during treatment. The Ktrans may be potential markers for predicting the response to CRT of NPC.

CLINICAL RELEVANCE/APPLICATION
DCE-MRI study prior and during IMRT process is available to early predict clinical response of local advanced NPC treated with CRT. Ktrans might become non-invasive prognostic markers of NPC.

MSRO32-07  
Prognostic Interplay of Positron Emission Tomography (PET)-based Metrics and Human Papillomavirus (HPV) Status in Oropharyngeal Squamous Cell Carcinoma (OP-SCC)

John Martin Floberg MD, PhD (Presenter): Nothing to Disclose, Pranshu Mohindra MD, MBBS: Nothing to Disclose, Nevein F. Ibrahim MD: Nothing to Disclose, Samuel Barasch MD: Nothing to Disclose, Heather M. Geye: Nothing to Disclose, David T. Yang MD: Nothing to Disclose, Scott B. Perlman MD: Nothing to Disclose, Timothy M. McCulloch MD: Nothing to Disclose, Greg Hartig MD: Nothing to Disclose
PURPOSE

To investigate the prognostic interplay of HPV status and PET-based metrics including maximum standardized uptake value (SUV_{max}), peak SUV (SUV_{peak}), metabolic tumor volume (MTV), and tumor glycolytic activity (TGA) in OP-SCC.

METHOD AND MATERIALS

With IRB approval, we identified 352 patients with OP-SCC treated with radiotherapy from 1990-2010. Patients with pre-treatment PET scans and known HPV status were identified. SUV_{max}, SUV_{peak}, MTV (all tumor above 50% of SUV_{max}), and TGA (MTV*SUV_{mean}) were obtained for both primary tumor (P) and lymph nodes (N). Means were compared using the t-test. Kaplan-Meier log-rank test and Cox regression analysis were performed for freedom from recurrence (FFR) and overall survival (OS); patients distributed across median values.

RESULTS

125 patients had PET scans available for analysis (mean follow-up 2.8 years), of which HPV status was available for 72 patients (60 positive, 12 negative). The mean P- and N- SUV_{max}, SUV_{peak}, MTV, and TGA values were not significantly different between the HPV positive and negative groups. Measures predictive of 3-year OS included low P-TGA (92 v. 76%, p=0.02) and low P-MTV (90 v. 85%, p=0.05). Low P-TGA was also predictive of improved FFR (94 v. 77%, p=0.01). Non-significant but distinct separation of FFR survival curves was seen with P-SUV_{max}, SUV_{peak}, and MTV. Similar separation was noted in P-FFR and distant-FFR by using primary tumor metrics, while nodal-metrics did not appear to display any trends. On Cox regression analysis for FFR, HPV status was the dominant factor when compared to each of the PET-metrics individually, except P-TGA which was also independently significant (HR: 0.19, p=0.01) and P-SUV_{max} (HR: 0.3, p=0.09). In addition to HPV status, both P-TGA and P-SUV_{max} provided additional stratification of patients into four separate cohorts based on FFR, with significant stratification effect in the HPV positive population.

CONCLUSION

While the dominant prognostic impact of HPV status is clearly noted, PET-metrics, particularly P-TGA and P-SUV_{max} may provide additional prognostic information in OP-SCC. The interplay of these important prognostic factors will be further defined using large prospective databases.

CLINICAL RELEVANCE/APPLICATION

PET imaging metrics provide additional stratification of patient cohorts beyond HPV status. This prognostication, if validated prospectively, could help further individualize treatment recommendations.

Low Baseline Lymphocyte Count and Lymphocyte to Neutrophil Ratio May Predict Poorer Overall Survival in Patients with Head and Neck Cancer Treated with Radiation Therapy: Role of Immunofunction?

Junjian   Huang  BS (Presenter):  Nothing to Disclose , Joseph   Kaminski  MD :  Nothing to Disclose , Jeff   Campbell :  Nothing to Disclose , Jing   Zhao :  Nothing to Disclose , Paul   Stanton :  Nothing to Disclose , Ahmad   Al-Basheer  PhD :  Nothing to Disclose , Byron   Grady  Dasher  MD :  Nothing to Disclose , Jerry   W.   Howington  MD :  Nothing to Disclose , Jed   Weems  Howington  MD :  Nothing to Disclose , John   Stewart :  Nothing to Disclose , William   Dean  Martin  MD :  Nothing to Disclose , Chris   Shells  MD :  Nothing to Disclose , Feng-Ming   Kong  MD, PhD :  Nothing to Disclose

PURPOSE

Low total lymphocyte count and lymphocyte to neutrophil ratio are directly related to immunofunction and have been reported as poor prognostic indicators for multiple cancers at various stages after anticancer treatment. We hypothesized that baseline lymphocyte count and lymphocyte to neutrophil count correlate with overall survival in patients with head and neck cancer treated with radiation based therapy.

METHOD AND MATERIALS

This is a retrospective analysis of consecutive patients with non-metastatic Stage I-IV head and neck cancer who were treated with radiation therapy from January of 2003 to October of 2013. Pre-treatment complete white blood count, demographic, and clinical variables were extracted from medical records and vital status was obtained by using the Social Security Death Index. Variables and outcomes were analyzed using tests of R.

RESULTS

Of the 348 patients reviewed, 254 had baseline complete blood counts (Median age 57, Male 178, Female 76, 201 received chemotherapy). The median follow-up duration is 22 months. Higher baseline lymphocyte count and lymphocyte to neutrophil ratio were significantly associated with lower mortality (HR: 0.34, 95% CI 0.23-0.53, p<0.000001 and HR: 0.91, 95% CI 0.84-0.97, p=0.005). The 2 year survival rates for patients with normal lymphocyte counts versus patients with abnormal counts were 65% (CI: 0.724-0.865, 0.567-0.745) and 51% (CI: 0.714-0.941, 0.476-0.783), respectively. Furthermore, higher neutrophils (HR: 1.07 95% CI 1.001-1.141, p=0.047) and seg counts (HR: 1.04, p=0.0007) were correlated with increased mortality. Stage IV cancer patients had worsened overall survival compared to Stage I-III (HR 2.2, CI: 1.3-3.6, P=0.0026). Other variables such as chemotherapy(HR: 0.7, P=0.174), age, and gender were not significantly associated with overall survival.
CONCLUSION

This study demonstrates that baseline lymphocyte count and lymphocyte to neutrophil ratio is directly correlated with overall survival in patients with head and neck cancers treated with radiation therapy. This result suggests immune function may play an important role in overall survival of head and neck patients. Prospective studies are needed to validate this interesting finding.

CLINICAL RELEVANCE/APPLICATION

To advocate the property of pre-treatment baseline lymphocyte count and lymphocyte to neutrophil ratio as prognostic indicators for overall survival in HEENT cancer patients treated with radiation therapy.
fluorescence of 10000 gated cells.

Results: C33A cells (HPV-negative) showed a minimal enhanced expression of pRB after RT with photons or C12 (0 Gy=1.0, 2 Gy=1.09, 7 Gy=1.4, 2 GyE=1.3, 7 GyE=1.1). There was no effect of photon or C12 irradiation on p53 expression in C33A cells. Caski cells (HPV16/18 positive) showed increased expression after photon RT (2 Gy=1.3, 7 Gy=1.7). Irradiation with C12 induced a strong increase of pRB expression (2 GyE=7.7, 7 GyE=8.3). There was a minimal change of p53 expression after RT (2 Gy=1.3, 7 Gy=1.2, 2 GyE=1.6, 7 GyE=1.5). S12 cells (HPV 16 integrated) showed a decrease of pRB expression after RT with photons (2 Gy=0.47, 7 Gy=0.38). Irradiation with C12 enhanced the expression of pRB positive cells (2 GyE=1.8, 7 GyE=1.94), but showed no significant expression of p53 in the control group. W12 cells (HPV 16 episomal) showed no change of pRB expression in the control group or after RT. C12 RT induced an increase of pRB expression (2 GyE=1.5, 7 Gy=2.9). There was no significant change of p53 expression in W12 and S12 cells after RT. C12-RT showed no effect on cell cycle distribution in W12/S12 and C33A cells. 48 h after irradiation with 7 Gy photons in C33A cells and 24 h after RT in S12 cells a G2/M-block was induced.

Conclusions: The effect of carbon-ion-RT on protein expression seems to be dependent on HPV-status and type of protein with no effect on p53 or on HPV-negative cells, but a strong effect on pRB expression in HPV-positive cells. The converse effect of carbon-ion-RT compared to photon-RT on HPV positive cell with integrated HPV regarding pRB expression indicates that carbon-ion therapy might overcome HPV-integration induced radioresistance.


April Alexander Bailey MD (Presenter): Nothing to Disclose, Lindsay Hwang BS : Nothing to Disclose, Yin Xi : Nothing to Disclose, Matthew McKeever BS : Nothing to Disclose, Kevin V. Albuquerque MD : Nothing to Disclose

Purpose

Geographically map lymph node metastases, using CT in advanced cervical cancer patients, and correlate with standard conformal radiation planning techniques.

Method and Materials

IRB-approved study of imaging, demographic and treatment data for patients with advanced cervical cancer referred for definitive radiation therapy between 2006-2013. Pelvic (PLN) and paraaortic (PALN) lymph nodes were mapped on baseline CT examinations. PLN >8 mm and PALN >10 mm were considered abnormally enlarged and a surrogate for nodal metastatic disease. The anatomic location was recorded for PLN (common, internal, external iliac) and PALN (left paraaortic LPA, aortocaval AC, right paracaval RPC). Cranio-caudal position and location with relation to the adjacent vertebral body for all PALN was recorded to create nodal maps. PET/CT was also obtained in 71.4% of this population; FDG-avid nodes were compared to the results of CT after primary analysis.

Results

There were 77 patients included. PLN were identified in 74 of which 23 also had PALN. There were 3 additional patients with isolated PALN. Distribution of nodal disease in the pelvis was predominantly external iliac. The mean age of patients with and without PALN was different (55 v. 46.5 years, p=0.002). Higher FIGO stage (III or IV) also had a higher likelihood of PALN (p=0.0371). The most common PALN distribution was LPA (82.6%). No isolated RPC nodes were identified. Nearly all PALN (95.6%) were below the renal arteries. There was no correlation with type of PLN or presence of lower PALN to predict upper PALN indicating necessity to treat the entire infra-renal PALN chain with the presence of a single PALN. For the subset of patients with PET/CT evaluation, when a size threshold of >8 mm was used in the pelvis, no FDG-avid nodes were below detection, but if >10 mm was used in the pelvis, 13 out of 58 patients had metabolically active lymph nodes that would not have been identified.

Conclusion

Short axis PLN size of 8 mm on CT was a good surrogate for PET avidity which will assist resource poor locations. Geographical mapping of nodal size and patterns aid CRT planning by directing radiation port size and extent.

Clinical Relevance/Application

Advanced cervical cancer treatment can be tailored by reviewing the common distribution patterns of pelvic and paraaortic lymphadenopathy on CT in an indigent US population.

MSRO35-04 Prognosis and Survival of Women with Endometrial Carcinoma after Adjuvant Radiotherapy

Robert Foerster (Presenter): Nothing to Disclose, Robert Kluck : Nothing to Disclose, Stefan Rieken : Nothing to Disclose, Juergen Debus MD, PhD : Nothing to Disclose, Katja Lindel : Nothing to Disclose

Purpose/Objective(s)

Endometrial cancer is the most common gynecologic malignancy. While therapy guidelines are widely established for endometrioid carcinomas, optimal treatment of subgroups with highly malignant histologies remains unclear. The purpose of this retrospective analysis was to determine the meaning of adjuvant radiotherapy (RT) for clinical outcome and to define prognostic factors. Materials/Methods: 380 patients (pts) underwent adjuvant radiotherapy (RT) for endometrial carcinomas at the University Hospital Heidelberg, Germany, from 2004 until 2012. Median age at diagnosis was 66 years. The majority were early stage carcinomas (FIGO I 68.7%, FIGO II 13.6%, FIGO III 16.3%, FIGO IV 1.4%). 96.9% underwent lymphadenectomy (LNE) and 3.6% received additional adjuvant chemotherapy (ChT). 52.6% were treated with intravaginal brachytherapy (IVB) and 47.4% with IVB + external beam radiotherapy (EBRT). All pts were included in this retrospective cohort study and statistically evaluated (chi-square, LogRank test, Cox
Results: Five year local recurrence free survival (LRFS), distant metastases free survival (DMFS) and overall survival (OS) were 90%, 88.2% and 77.8% respectively. 22.2% died, 8.9% had a local recurrence and 8.9% developed distant metastases. Better LRFS was associated with lower FIGO stage (p=0.002), smaller tumor size (p<0.001), N0 (p<0.001), L0 (p<0.001), V0 (p=0.003), R0 (p<0.001) and after LNE (p<0.016). DMFS was prolonged with age <66 (p=0.005), lower FIGO stage (p=0.006), smaller tumor size (p<0.001), N0 (p=0.001), lower grading (p=0.039), endometrioid histology (p=0.043), L0 (p=0.001), V0 (p<0.001) and after LNE (p=0.006). OS was improved with age <66 years (p=0.014), lowerFIGO stage (p<0.001), smaller tumor size (p<0.001), N0 (p<0.001), lower grading (p<0.001), endometrioid histology (p<0.001), L0 (p<0.001), V0 (p<0.001), R0 (p<0.001) and after LNE (p=0.004). In stage I there were no statistically significant survival differences for grading in LRFS, DMFS or OS. In multivariate analysis for OS age (p=0.019), grading (p=0.014), histology (p=0.001) and blood vessel infiltration (p=0.001) remained as prognostic factors. For DMFS only blood vessel infiltration (p=0.001) remained and for LRFS lymph vessel infiltration showed a tendency towards statistical significance. Conclusions: RT ensures good local control rates in carcinomas of the uterus. However, carcinomas with non-endometrioid histology or advanced stages with high grading have a substantially worse prognosis and these pts are in need of a combined local and systemic therapy approach. For endometrioid carcinomas vessel infiltration might be the best predictive factor for a benefit from systemic therapy.
Refresher/Informatics

MSRO35-08 Feasibility of Cervical Brachytherapy with a Novel 50 kV Electronic Brachytherapy Source

J. Spencer Thompson MD (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objectives
To explore the feasibility of using a 50 kV electronic source for delivery of brachytherapy treatment in cervical cancer.

Materials/Methods
Two patients have been treated using the electronic source, with instruments provided by the manufacturer (tandem and colpostats). Both patients received 45 Gy to the pelvis at 1.8 Gy per fraction with weekly cisplatinum at 40 mg/m². A parametrical boost was then given to 50.4 Gy for the first patient and to 54 Gy for the second. After 36 Gy, both patients were implanted under general anesthesia and dilatation of the cervical os to sufficient width in order to permit tandem insertion under ultrasound guidance with a cervical stopper attached to the tandem at the distance from the tip of the tandem to correspond the sounded depth of the uterus. Brachytherapy was performed weekly while external beam treatment was still occurring and then twice weekly to complete treatment within 8 weeks. Colpostat covers were chosen to provide maximum lateral displacement of the vaginal mucosa. CT-based three dimensional planning with non-contrast images was utilized after fixation of the instruments and packing of the vagina to push the bladder and rectum as far away as possible. Dose was prescribed to point A using 5.5 Gy per fraction for one patient and 6 Gy per fraction for the second patient (who had a larger tumor with initial clinical stage IIIIB disease). Five fractions were performed for each patient.

Results
The implantation procedure, treatment planning, treatment delivery and post-anesthesia recovery took over 6 hours in the first insertion attempt, but the total required time had dropped to approximately 3 hours once all staff became familiar with the instruments and software. There were no observed complications from treatment and both patients tolerated anesthesia and brachytherapy well. Mean dose to point A was 5.57 Gy for patient 1 and 5.68 Gy for patient 2. Corresponding doses for points B and H were 1.26 Gy and 1.28 Gy; and 4.59 Gy and 5.68 Gy, respectively. Mean dose to the bladder was 1.37 Gy for patient 1 and 1.61 Gy for patient 2. The dose (D 5) received by 5% of bladder volume was 3.64 Gy for patient 1 and 4.49 Gy for patient 2. Mean rectum doses were 1.97 Gy and 1.13 Gy and rectum D 5 was 2.37 Gy and 2.95 Gy for patients 1 and 2, respectively.

Conclusions
To our knowledge, this represents the first report of electronic-source brachytherapy for cervical cancer and was accomplished with acceptable dosimetry and clinical tolerability.

MSRO35-09 Clinic Outcomes of Post-Operative Endometrial Cancer Patients Treated with Vaginal Brachytherapy Alone

Katarina Petras (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective: To assess the clinical outcomes of post-operative endometrial cancer patients undergoing adjuvant vaginal brachytherapy (VBT).

Materials and Methods: The records of all endometrial cancer patients treated with adjuvant VBT alone following total abdominal hysterectomy and bilateral salpingo-oophorectomy (TAH/BSO) at our institution between 2006 and 2010 were retrospectively reviewed. VBT was delivered with vaginal cylinders using high-dose-rate (HDR) iridium-192 radiation. All relevant clinical and brachytherapy plan dosimetric data were collected. For the purpose of this study, patients were restaged according to FIGO 2009 classification. Any short-term or long-term treatment related toxicity, as well as the incidence of local, regional, and distant failure was recorded. Results: A total of forty-five patients were examined. The median age was 67 years (range 37 - 86). Median follow-up from the date of the last VBT fraction was 39.2 months (range 6.1 - 83.0). All patients but one received 22 Gy in 4 fx prescribed to 0.5 cm depth (one patient received 21 Gy in 3 fx). Thirty-six percent of patients received concurrent chemotheraphy (most frequently with carboplatin and taxol). The number of stage IA, IB, II, and IIIA patients were 20, 13, 11, and 1, respectively. Twenty-nine had endometrioid-type adenocarcinoma (64.4%), 12 were papillary serous (26.7%), 3 were clear cell (6.7%), and 1 was a mixed mesenchymal tumor (2.2%). The median cylinder apex point dose, as a percentage of total prescription dose, was 100% (range 80 - 130%). The median treatment length was 3.1 cm (range 1.5 - 5.0 cm). Treatment was well tolerated as no patients experienced any on-treatment or long-term toxicity (fatigue, GI, GU, or skin) greater than grade 1. Two patients failed locally (1 adenocarcinoma, 1 clear cell), 5 patients failed regionally (1 adenocarcinoma, 4 papillary serous), and the mixed mesenchymal tumor patient failed distally. Median time to recurrence was 12.2 months from the date of the last VBT fraction (range 3.9 - 41.2). One local failure occurred at the vaginal cuff (adenocarcinoma, grade 2, stage IA) while the other occurred in the vagina location NOS (clear cell, grade 3, stage IA). Of the four papillary serous regional recurrences, 2 were stage IA, 1 was stage IB, and 1 was stage II; all 4 patients received concurrent chemotherapy.

Conclusion: Satisfactory local control (96%) was achieved in our patient population with minimal toxicity. Since most of our regional failures were of papillary serous histology, consideration should be given to pelvic nodal irradiation in addition to, or in lieu of, VBT in this particular subset of patients.
Participants

- Daniel L. Rubin, MD, MS (Presenter): Nothing to Disclose
- Adam Eugene Flanders, MD (Presenter): Nothing to Disclose
- Elizabeth S. Burns, MD, MPH (Presenter): Stockholder, Cellerix Biosciences, Inc; Stockholder, NeuWave Medical Inc
- Raghunandan Vikram MBBS, FRCP (Presenter): Nothing to Disclose
- Ross Warren Filice, MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1. Understand the new Big Data paradigm of radiology and emerging scientific areas in breast, brain and renal imaging that are leveraging this to drive new radiological insights.
2. Understand the Annotation and Image Markup (AIM) standard for image metadata and tools that use it to enable radiologists to make their observations explicit and machine-accessible.
3. Learn how AIM can support radiology clinical workflow, help referring physicians, be used outside the clinical environment, support research objectives, support regulatory objectives, improve regulatory science, facilitate new biomarker development and validation, help with meta-analyses across disparate trial data.

**ABSTRACT**

AIM brings tremendous benefits to clinical radiology by standardizing annotation documentation, allowing more specific and customizable searching of annotations, enabling objective and computable analysis of measurements, and allowing clinicians to more easily consume measurement data. But, AIM also has many important use cases outside of the clinical setting. Clinical trials, many of which include imaging and measurement data, are the foundation of medical product approval and regulation. Regulators must be able to easily review increasing large amounts of data to make an educated decision regarding a new medical product. By submitting imaging measurement data in a standard format, such as AIM, regulators could more easily review this data. Additionally, as meta-analysis of data across multiple trials becomes more and more useful - both in the regulatory as well as the research settings - documenting measurements in standard formats better facilitates these analyses. Finally, standardizing measurement data and aggregating multiple datasets could better allow for new imaging biomarker discovery and validation that might lead to better response criteria for use both clinically and in the approval of new medical products.

**Active Handout**


### RCB32

**Overview of RSNA's Teaching File Software (MIRC®)**

**Refresher/Informatics**

- **AMA PRA Category 1 Credits ™:** 1.50
- **ARRT Category A+ Credits:** 1.50
- **Tue, Dec 2 10:30 AM - 12:00 PM** Location: S401CD

**Participants**

- William J. Weadock, MD (Presenter): Owner, Weadock Software, LLC
- Stacy Dorothy O’Connor, MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1. Learn the features of the RSNA’s MIRC software for teaching files.
2. Learn how to download and install the software.
3. Learn to use the RSNA MIRC Wiki to obtain documentation on the software.

### RCC32

**Workflow Tools to Optimize Departmental Operations**

**Refresher/Informatics**

- **AMA PRA Category 1 Credits ™:** 1.50
- **ARRT Category A+ Credits:** 1.50
- **Tue, Dec 2 10:30 AM - 12:00 PM** Location: SS01ABC

**Participants**

- Moderator: Bradley J. Erickson, MD, PhD: Stockholder, Evidentia Health, Inc

**Sub-Events**

#### RCC32A

**Managing Your Department with Workflow Engines**

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

**LEARNING OBJECTIVES**

1. Become familiar with workflow engine technology.
2. Understand how workflow engines can be used within...
ABSTRACT
Workflow engines are a commonly used technology in many process-oriented industries like manufacturing and logistics. However, they have seen limited application in radiology or medicine. There are a few reasons why that might be, but the increasing pressures to increase clinical efficiency and expectations of adherence to evidence-based medicine principles may drive adoption of workflow engines. There are some important enabling technologies that may encourage increased use of workflow engines in healthcare, and radiology specifically. These include the SWIM workflow lexicon. The increased use and expectations for departmental dashboards will also reduce the barriers to implementing workflow engines. Some commercial entities are now building workflow technology into their systems. It is important to adopt technologies for workflow that are reliable and scalable as healthcare systems grow increasingly complex. Some examples of where workflow engines can support enterprise as well as departmental work will be examined.

RCC32B
Measuring Your Department with the SWIM Lexicon
Marc D. Kohli MD (Presenter): Research Grant, Koninklijke Philips NV Research Grant, Siemens AG
LEARNING OBJECTIVES
1) Describe existing heterogeneity of workflow terminology. 2) Explain benefits arising use of a standard nomenclature for workflow steps. 3) Provide details regarding how the SWIM lexicon could be applied in the learner’s environment.

ABSTRACT
In current practice, standard workflow steps such as the arrival of a patient to the imaging department, and completion of the exam are tracked in a very heterogeneous manner with imprecise terminology. In order to better understand and compare workflow across radiology departments, a common language must be devised and deployed. The SIIM Workflow Initiative in Medicine (SWIM) lexicon aims to address this challenge. We will illustrate how the SWIM lexicon can be used to measure and compare workflow in a radiology department.

RCC32C
Monitoring Your Department with Dashboards
Christopher D. Meenan (Presenter): Stockholder, Analytical Informatics, Inc
LEARNING OBJECTIVES
1) Understand why dashboards can be important. 2) Become familiar with dashboarding tools. 3) Understand organizational dynamics and driving change with data. 4) Learn methods to sustain quality improvements with.

ABSTRACT
Leveraging dashboards to measure and improve operational quality can be an effective way for clinical departments to navigate change. However, understanding which tools to use. Technology alone is often not enough, and Department’s may invest without realizing benefits. There are significant challenges including understanding and selecting key metrics, data quality issues, and driving organizational change.

SPCP31
Canada Presents: Beyond Diagnosis–How Cardiovascular Imaging Research in Canada is Improving Clinical Outcomes

LEARNING OBJECTIVES
1) Discuss recent practice changing cardiovascular imaging trials from across Canada with a focus on clinical outcomes and therapeutic impact. 2) Define novel opportunities for Trans-Canadian collaboration in cardiovascular outcomes research enabled by imaging networks and shared data registries. 3) Review the potential benefits and limitations that the Canadian Healthcare delivery model may have on outcomes focused imaging research.

This session is part of Canada Presents at RSNA 2014.
LEARNING OBJECTIVES

This session is part of Canada Presents at RSNA 2014.

SPCP31B

The Impact of Integration of a Multidetector Computed Tomography Annulus Area Sizing Algorithm on Outcomes of Transcatheter Aortic Valve Replacement: A Prospective, Multicenter, Controlled Trial

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

LEARNING OBJECTIVES

1) Discuss historical sizing algorithms for the balloon expandable prostheses. 2) Review the methods for measuring the annulus with MDCT. 3) Define an MDCT area/perimeter based sizing algorithm for balloon expandable TAVR and review the data supporting its integration.

This session is part of Canada Presents at RSNA 2014.

SPCP31C

Refining the Phenotype of Genetic Hypertrophic Cardiomyopathy with Cardiac MRI

Andrew Michael Dominic  Crean  MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the histopathologic basis of late gadolinium enhancement in HCM and how best to measure it. 2) To appreciate the added value of late gadolinium enhancement in prognostication in HCM. 3) To learn about several under-appreciated phenotypic signs of HCM that may be present even in so-called Ôgene-positive phenotype-negativeÕ HCM. This session is part of Canada Presents at RSNA 2014.

SPCP31D

A New Paradigm for Cardiac CT Imaging: Quantitative Assessment of Perfusion and Late Enhancement

Ting-Yim  Lee  MSc, PhD (Presenter):  Research Grant, General Electric Company Royalties, General Electric Company

LEARNING OBJECTIVES

1) Using quantitative CT perfusion and late enhancement imaging to identify different tissue states in acute myocardial infarction. 2) Technical requirements for generation of these quantitative functional maps with clinical CT scanners. 3) Pitfalls in quantitative CT perfusion and late enhancement imaging. 4) Further applications of quantitative cardiac CT imaging.

This session is part of Canada Presents at RSNA 2014.

SPCP31E

Modeling of Abdominal Aortic Aneurysm before, during and after Endovascular Repair: Potential Impact on Patient Management

Gilles P.  Soulez  MD (Presenter):  Speaker, Bracco Group Speaker, Siemens AG Research Grant, Siemens AG Research Grant, Bracco Group Research Grant, Cook Group Incorporated Research Grant, Object Research Systems Inc

LEARNING OBJECTIVES

1) Know the risk factors of abdominal aortic aneurysm (AAA) rupture and the role of maximal diameter (D-max) measurement in therapeutic algorithm. 2) Discuss the variability of D-max measurement and the importance of standardized measurement to improve reproducibility. 3) Understand the challenge of AAA segmentation on CT scanner examination before and after endovascular repair (EVAR) and on unenhanced studies. 4) Understand the utility of AAA modeling to predict AAA rupture, improve endovascular repair (EVAR) planning, EVAR rehearsal, and patient follow-up after EVAR.

This session is part of Canada Presents at RSNA 2014.

ABSTRACT

Aneurysm size is the most important predictive factor for AAA rupture. Accordingly, rupture risk increases with size, with a 3-15% risk per year for those with a 5-6 cm aneurysm, 10-20% for 6-7 cm aneurysms, 20-40% for 7-8 cm aneurysms, and 30-50% for those with a diameter greater than 8 cm. AAA growth rate is correlated to its diameter and to the risk of rupture. The main indications for a procedure are Dmax >5.5 cm in men, >5.0 to 5.4 cm in women, or symptomatic AAA. Computer modeling have raised the possibility of patient specific risk prediction based on AAA geometry. After computer modeling, AAA with a higher bulge location (P<.020) and lower mean averaged area (P<.005) are associated with AAA rupture however the addition of these indices in a predictive model based on current treatment criteria modestly improved the accuracy to detect aneurysm rupture. AAA segmentation is the first step before AAA modeling. CT-scanner is the modality of choice for AAA evaluation before and after endovascular repair (EVAR). AAA lumen segmentation can be easily performed after contrast injection but thrombus segmentation is far more challenging. Considering the high incidence of renal failure in this population, patient follow-up after EVAR with unenhanced CT-scanner is needed. Semi- automated
segmentation of AAA on unenhanced CT-scanner can also be achieved with a high reproducibility. This open the door to patient follow-up with low-dose unenhanced CT-scanner. In this setting, Dmax or AAA volume measurement can be calculated while minimizing exposure to iodine contrast and ionizing radiation to exclude EVAR failure. AAA modeling is a necessary step for EVAR planning and stent selection. AAA can be used to enable a 2D/3D image registry to improve guidance during EVAR procedure and minimize fluoroscopy time and contrast injection. Finally, modeling of AAA can be combined with finite element analysis to enable EVAR rehearsal.

SPCP31G
Prevalence of Extracranial Venous Narrowing on Catheter Venography in People with Multiple Sclerosis, Their Siblings, and Unrelated Healthy Controls: A Blinded, Case-control Study
Darren Klass MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the incidence of MS and its impact on healthcare in Canada. 2) Discuss the design of the assessor-blinded, case controlled study and the difficult task of ensuring the strict blinding protocol was adhered to. 3) Discuss the findings, the strength of the blinding in the study and the impact of the study results on future interventional radiology studies related to the subject. 4) Discuss the importance of working in a well-functioning interventional radiology team.

This session is part of Canada Presents at RSNA 2014.

ABSTRACT

Background Chronic cerebrospinal venous insufficiency has been proposed as a unique combination of extracranial venous blockages and haemodynamic flow abnormalities that occur only in patients with multiple sclerosis and not in healthy people. Initial reports indicated that all patients with multiple sclerosis had chronic cerebrospinal venous insufficiency. We aimed to establish the prevalence of venous narrowing in people with multiple sclerosis, unaffected full siblings, and unrelated healthy volunteers. Methods: An assessor-blinded, case-control, multicentre study of people with multiple sclerosis, unaffected siblings, and unrelated healthy volunteers was conducted. Study participants were enrolled between January, 2011 and March, 2012, and they comprised 177 adults: 79 with multiple sclerosis, 55 siblings, and 43 unrelated controls, from three centres in Canada. Catheter venography data were available for 149 participants and ultrasound data for 171 participants. Findings: This study revealed a low incidence of chronic cerebrospinal venous insufficiency in all groups: 2% of people with multiple sclerosis, 2% of siblings and 3% of unrelated controls (p=0·41 for comparison with patients with multiple sclerosis), and 70% of unrelated controls (p=0·82). The ultrasound criteria were fulfilled in 44% of participants with multiple sclerosis, 31% of siblings (p=0·15 for comparison with patients with multiple sclerosis) and 45% of unrelated controls (p=0·98). Conclusions: Chronic cerebrospinal venous insufficiency occurs rarely in both patients with multiple sclerosis and in healthy people. Extracranial venous narrowing of greater than 50% is present in 74% of people with multiple sclerosis, 66% of siblings (p=0·41 for comparison with patients with multiple sclerosis), and 70% of unrelated controls (p=0·82). The ultrasound criteria were fulfilled in 44% of participants with multiple sclerosis, 31% of siblings (p=0·15 for comparison with patients with multiple sclerosis) and 45% of unrelated controls (p=0·98).
LEARNING OBJECTIVES

This session is part of Canada Presents at RSNA 2014.

SSG01

Breast Imaging (Diagnostics and Treatment Monitoring)

Scientific Papers

AMAPRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50

Tue, Dec 2 10:30 AM - 12:00 PM  Location: E451A

Sub-Events

SSG01-01

Pathologic Response to Neoadjuvant Chemotherapy in Triple-negative Breast Cancer: Association with Pretreatment Breast MRI Features

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

PURPOSE

To evaluate whether pretreatment MRI findings were distinguishable between responders and non-responders in triple-negative (ER-/PR-/HER2-) breast cancer (TNBC) patients who received neoadjuvant chemotherapy.

METHOD AND MATERIALS

IRB-approved retrospective review of our database identified 113 TNBC patients who underwent pretreatment breast MRI and neoadjuvant chemotherapy between January 2005 and December 2009. Two experienced breast radiologists reviewed MRI and mammograms without knowledge of clinicopathologic findings based on BI-RADS lexicon. All interpretations were agreed upon prior to being recorded. Pathologic complete response (pCR) was defined as the absence of invasive tumor cells in the resected breast specimen. Twenty-two (19.5%) patients achieved pCR and 91 (80.5%) showed non-pCR. Association of pCR status with imaging features was assessed using Fisher's exact test or the chi-squared test.

RESULTS

Median age was 43 years for both pCR and non-pCR groups. Breast cancer stage at presentation was not significantly different between the groups (p = 0.065). Irregular-shaped masses (p < 0.001, 96.7% vs 31.8% [non-pCR vs pCR]), irregular-marginned masses (p < 0.001, 91.4% vs 63.6%), presence of intratumoral high signal intensity on T2-weighted image (p = 0.002, 68.1% vs 31.8%), multifocality or multicentricity (p = 0.002, 39.6% vs 4.5%), and masses with calcifications seen on mammography (p = 0.043, 34.1% vs 13.6%) were significantly associated with non-pCR in TNBC patients. Features not statistically associated with pCR status included an internal enhancement pattern (p = 0.614), fibroglandular tissue on MRI (p = 0.651), background parenchymal enhancement (p = 0.319), and lymph node enlargement (p = 0.182).

CONCLUSION

Pretreatment MRI features in TNBC patients were shown to differ between responders and non-responders to neoadjuvant chemotherapy.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates that TNBC response to neoadjuvant chemotherapy could be predicted using pretreatment MRI features.
Role of T2 Mapping in Diagnosis and Neoadjuvant Chemotherapy of Breast Cancer

Li Liu MD (Presenter): Nothing to Disclose, Bo Yin MD: Nothing to Disclose, Weijun Peng MD: Nothing to Disclose

PURPOSE

To investigate 1) use of quantitative analysis of T2 relaxation time in differentiating malignant from benign breast lesions and therefore increase the diagnostic accuracy of breast MRI; 2) change in T2 relaxation time of breast cancer before and after neoadjuvant chemotherapy (NAC).

METHOD AND MATERIALS

Of the total 67 patients, 46 have malignant tumors while 21 have benign pathology. Twenty-six of the 47 malignant cases underwent NAC. MRI T2-mapping was performed in all patients. In patients with NAC, T2-mapping was performed before and after NAC. T2 relaxation times were obtained by using Funtool software on AW 43 workstation. Pathological response to NAC was assessed according to Miller#Payne response score. Statistical analysis was performed on T2 relaxation times of malignant and benign lesions, before and after NAC.

RESULTS

The mean T2 relaxation time in the malignant cases was 82.69 ±15.37ms, whereas the T2 relaxation time in benign cases was 95.48±26.51ms. Difference in T2 relaxation time between malignant and benign cases is statistically significant (P=0.015 <0.05). In 26 cases with NAC, the mean T2 relaxation time was 81.34±13.68ms and 64.50±8.71ms before and after NAC respectively. Difference in T2 relaxation time between the pre- and post- NAC is significant (P=0.00<0.05). Based on the MP response score, the mean post-NAC T2 relaxation time in 23 responders out of 26 NAC cases (63.18±8.37ms ) was significantly shorter than that in non-responders (74.62±2.32ms) (P=0.029

CONCLUSION

T2 relaxation time in benign lesions was found to be significantly longer than that in malignant lesions. Quantitative measurement of T2 relaxation time might provide new diagnostic parameter to breast MRI. T2 relaxation time in breast cancer was reduced after NAC, particularly in the responders. Measurement of T2 relaxation time change is a potential new tool to assess the response to NAC.

CLINICAL RELEVANCE/APPLICATION

Measurement of T2 relaxation time change is a potential new tool to assess the response to NAC and diagnosis breast cancer.

Correlation between Magnetic Resonance Imaging Characteristics and Breast Cancer Oncotype DX Score

Katerina Dodelzon MD (Presenter): Nothing to Disclose, Jennifer Chun MPH: Nothing to Disclose, Shira Schwartz: Nothing to Disclose, Sidney Law BS: Nothing to Disclose, Elizabeth Kern MPH: Nothing to Disclose, Freya Schnabel MD: Nothing to Disclose, Linda Moy MD: Nothing to Disclose

PURPOSE

Oncotype DX breast cancer 21 gene assay recurrence score (RS) is used to predict disease recurrence and response to chemotherapy in order to offer patients the highest treatment benefit to risk ratio. The purpose of this study was to assess whether magnetic resonance imaging (MRI) features can be used to predict Oncotype RS in patients with newly diagnosed, estrogen receptor (ER) positive invasive breast cancer.

METHOD AND MATERIALS

This was an IRB-approved HIPAA-compliant retrospective review of 727 women with newly diagnosed invasive breast cancer that were ER positive. Of 727 women, 59 had both Oncotype testing and preoperative MRI at our institution. Variables of interest included age, menopausal status, tumor characteristics, Oncotype RS, mammographic breast density, background parenchymal enhancement (BPE), and other MR imaging characteristics (lesion type, shape, mass enhancement, diameter, volume, presence on first post-contrast imaging, and contrast enhancement kinetics). Statistical analyses were performed using ANOVA and linear regression.

RESULTS

Of 59 patients, the majority had invasive ductal carcinoma (74%) and were Stage I and II (98%), progesterone receptor (PR) positive (88%) and Her2Neu negative (93%). 37 of 59 patients (63%) had pre-menopausal status which was significantly associated with a lower oncotype score (p=0.05). Patients with higher Oncotype RS were significantly more likely to have IDC on histology (p= 0.04). When looking at the MRI tumor characteristics, T2 hyperintensity was significantly associated with higher Oncotype RS (p=0.01). Other MRI features, including tumor size, morphology, and dynamic kinetic enhancement patterns were not significantly associated with Oncotype RS. As expected, Ki-67 proliferation index was statistically associated with Oncotype RS (p=0.0009).

CONCLUSION

Our study did not support the findings of previous work that have looked at Oncotype RS and MRI features. We
found that T2 hyperintensity may play a role in predicting tumor Oncotype RS. Morphology, size and enhancement characteristics do not reliably predict tumor recurrence or response to chemotherapy.

**CLINICAL RELEVANCE/APPLICATION**

Only tumor T2 hyperintensity may have utility in predicting tumor recurrence and response to chemotherapy in patients diagnosed with ER positive breast cancer.

**SSG01-04**

**Breast Imaging Changes of Invasive Cancers on Dynamic Contrast-enhanced and Diffusion-weighted MR Imaging: Correlation with Molecular Subtypes**

**Li Na, Zhang MD (Presenter):** Nothing to Disclose, Song Chen: Nothing to Disclose, Shao Wu Wang MD: Nothing to Disclose, Qingwei Song BS, BEng: Nothing to Disclose, Ailian Liu MD: Nothing to Disclose

**PURPOSE**

To evaluate the breast characteristics of invasive cancers on dynamic contrast-enhanced MR imaging (DCE-MRI) and diffusion-weighted MR imaging (DWI) assessed as parameters in comparison with different molecular subtypes.

**METHOD AND MATERIALS**

This retrospective study was approved by the institutional review board and requirement for informed consent was waived. A total of 164 lesions in 161 women who underwent preoperative breast imagings both DCE-MRI and DWI were reviewed. According to the receptor status, tumour subtype was categorized as triple-negative breast cancer (TNBC), luminal A, luminalB, and Herb 2+. The following lesion characteristics were recorded: DCE morphology and maximum lesion size, initial phase peak enhancement, delayed phase enhancement categorized by a single type of kinetics comprising the largest percentage of enhancement (washout, plateau, or persistent) with CAD analysis, apparent diffusion coefficient (ADC) values, and contrast-to-noise ratio (CNR) at DWI with b values of 0 and 800 s/mm². Discriminative abilities of models were compared by using the area under the receiver operating characteristic curve (AUC).

**RESULTS**

Compared with other three subtypes (69 luminal A, 40 luminal B, and 21 Herb 2+), TNBC lesions exhibited smooth mass margin, larger maximum lesion size and rim enhancement (n=34, P<0.005). Significant differences in delayed phase enhancement (P<0.005) and CNR (P<0.001) were observed among four subtypes, while no differences in lesion shape (P=0.09), initial phase peak enhancement parameters (P=0.07) or mean ADC value (P=0.099). A multivariate model combining maximum diameter, CNR with b values of 800 s/mm² and delayed phase enhancement most significantly discriminated TNBC from other three subtypes (AUC=0.84).

**CONCLUSION**

In addition to the morphological features, DCE-MRI and DWI could provide novel quantitative information reflecting invasive cancers microenvironment changes, with a potential role in the differentiation of molecular subtypes and to facilitate lesion-specific targeted therapies.

**CLINICAL RELEVANCE/APPLICATION**

In addition to the morphological features, DCE-MRI and DWI could provide novel quantitative information reflecting invasive cancers microenvironment changes, with a potential role in the differentiation of molecular subtypes and to facilitate lesion-specific targeted therapies.

**SSG01-05**

**Role of MRI Diffusion, as an Adjunct to Contrast Enhanced MRI of The Breast, for the Evaluation of Patients with Locally Advanced Breast Cancer Receiving Neoadjuvant Chemotherapy**

Hebatalla H. Elkassas MD (Presenter): Nothing to Disclose, Maha Hussein Helal MD: Nothing to Disclose, Asmaa Abdelkhalik Abourabia MD: Nothing to Disclose, Naglaa Abdel Razek MD: Nothing to Disclose, Ola Khorousid MD, MSc: Nothing to Disclose, Ahmed Farahat MD, MSc: Nothing to Disclose, Mohamed Zedan MSc, MRCS: Nothing to Disclose, Ehab Mansour MD: Nothing to Disclose

**PURPOSE**

To assess the role of MRI diffusion in predicting further responders and non-responders, early during the course of neoadjuvant chemotherapy given to patients with advanced breast cancer. Another objective was to depict the role of diffusion imaging in the evaluation of residual disease at the end of treatment.

**METHOD AND MATERIALS**

Thirty-five patients with advanced breast cancer scheduled to receive neoadjuvant chemotherapy (NAC), between January 2013 and January 2014, were enrolled in this prospective study. MRI with diffusion weighted (DW) and contrast enhanced images were performed and parameters including number, size and apparent diffusion coefficient (ADC) values of lesions were recorded at 4 stages: before starting NAC, during (after the 1st and 2nd cycles) and after completion of NAC. The percentage changes in ADC values and tumor size, before and after the 1st and 2nd cycles were then calculated. Diagnostic performance of MRI (morphological and functional imaging) in predicting early response and assessing residual disease was then compared to the histopathological results.

**RESULTS**

The percentage increase in the ADC values, measured before and after the first cycle of NAC in responder
patients, was significant, while the change in tumor diameter found after the 2nd cycle was only of borderline significance. Following the first cycle of therapy, DWI had a sensitivity of 79% and a specificity up to 95% in differentiating responders from non-responders. The sensitivity and specificity for depicting residual tumor was 94% and 92% respectively for DW MR imaging, with a 89% and 94% results for contrast enhanced MR imaging.

CONCLUSION
Diffusion weighted MRI is a valuable tool in identifying responders and non-responders to NAC, in patients with advanced breast cancer early during their treatment course, hence selecting only patients that will benefit from NAC and avoiding non-responders any unnecessary toxicity. The overall accuracy of DWI in detecting residual disease is almost similar to that of contrast enhanced MRI and can act as a substitute in patients that cannot be given contrast.

CLINICAL RELEVANCE/APPLICATION
Early prediction of non responder by DWI to neoadjuvant chemotherapy could potentially spare them unnecessary toxicity. Accurate delineation of the residual tumor could enhance surgical outcomes.

SSG01-06

Diffuse Non-mass Enhancement (NME) May Safely Be Categorized as Background Parenchymal Enhancement
Adrienne Rebecca Newburg MD (Presenter): Nothing to Disclose, Chloe Muy-Chou Chhor MD: Nothing to Disclose, Leng Leng Young Lin BA, MD: Nothing to Disclose, Jennifer Gillman: Nothing to Disclose, Jin Ah Kim MD: Nothing to Disclose, Hildegard B. Toth MD: Nothing to Disclose, Linda Moy MD: Nothing to Disclose

PURPOSE
Differentiation of physiologic versus pathologic enhancement on breast MRI can present a diagnostic challenge. Background parenchymal enhancement (BPE) was recently incorporated into the 5th edition BIRADS lexicon, defined as the volume and intensity of fibroglandular tissue enhancement. However, physiologic enhancement may be non-uniform or asymmetric, and pathologic NME can be diffuse. We have observed that NME described as "diffuse" did not yield malignancy at follow-up or biopsy. Therefore, the purpose of the study was to determine frequency of subsequent malignancy on follow-up for NME described as diffuse.

METHOD AND MATERIALS
An IRB-approved, retrospective review of 5,837 consecutive breast MRIs performed from 2005-2011 identified 928 NME lesions for which follow-up or biopsy was recommended. We queried our database for the following terms: "diffuse NME" "scattered" "patchy areas" "bilateral stippled enhancement" or "likely benign fibrocystic change" in the MRI report impression. For purposes of this study these terms were categorized as diffuse. We identified 94/928(10%) cases which were evaluated by 2 fellowship-trained breast radiologists using 5th edition BIRADS lexicon. We sought to determine if enhancement pattern was benign and could be assigned one of 4 BPE categories. Final BIRADS assessment, BPE category and follow-up exams were recorded.

RESULTS
Mean age of patients with NME described as diffuse was 44 years, range 22-73. Of the 94 NME described as diffuse, 21/94(22%) had no further breast imaging at our institution. Of the remaining 73, 4(5%) underwent biopsy with benign results. No subsequent cancers were identified for 73/73 (100%) of diffuse NME at follow-up (mean 2.6 yrs, range 0.1 to 4.8). 1/73 (1.4%) patients developed an interval malignancy after 2.5 yrs of follow-up, which was biopsy-proven DCIS manifesting as a new linear focal area of NME distinct from the background enhancement. BPE categories for the 73 cases were 7/73(10%) minimal, 32/73(44%) mild, 29/73(40%) moderate, 5/73(7%) marked.

CONCLUSION
Diffuse NME had a 0% PPV for malignancy.

CLINICAL RELEVANCE/APPLICATION
Diffuse breast tissue enhancement may be classified as BPE, with no additional follow-up or biopsy required. The introduction of the term BPE into the BI-RADS lexicon is useful.

SSG01-07

Is the Predictive Value of BI-RADS 3, 4, and 5 Findings Detected on Screening and Diagnostic Breast MRI affected by Study Indication?
Sona Ajit Chikarmane MD : Nothing to Disclose, Catherine Streeto Giess MD (Presenter): Nothing to Disclose, Dorothy Amy Sippo MD : Nothing to Disclose, Robyn L. Birdwell MD : Nothing to Disclose

PURPOSE
To determine (1) the prevalence and predictive value of BI-RADS 3, 4, and 5 findings on breast MRI; and (2) the impact of study indication (screening versus diagnostic) and patient risk factors (personal or family history of breast cancer) on the predictive value of BI-RADS categories.

METHOD AND MATERIALS
An IRB approved, retrospective review of our breast MRI database from 2009-2011 (5778 contrast enhanced studies in 3360 patients) was performed. At our institution each breast receives an individual BI-RADS assessment. Breast MRI reports and electronic medical record were reviewed to obtain BI-RADS assessment, imaging features, patient demographics, and outcome data.
RESULTS
Overall, there were 9216 BI-RADS assessments assigned during the study period: 7879 (85.5%) BI-RADS 1/2, 567 (6.1%) BI-RADS 3, 715 (7.8%) BI-RADS 4, and 55 (0.6%) BI-RADS 5. The prevalence of BI-RADS 3, 4, and 5 was higher in studies performed for diagnostic (7.8%, 14.6%, 1.5%, respectively) than screening (5.2%, 4.0%, 0.07%) indications (p < 0.0001). A total of 734 biopsies were performed with 219 (29.8%) malignant and 515 (70.2%) benign outcomes. The overall negative predictive value (NPV) for BI-RADS 3 findings was 98.0% (11/567) with no difference observed by study indication (diagnostic, 98.4%; screening, 97.7%, p = 0.76). In patients without a personal or family history of breast cancer, the NPV of BI-RADS 3 was 100% (0/177). The highest cancer rate for BI-RADS 4 and 5 categories was in patients undergoing screening for personal history of breast cancer (26.3%, 100%).

CONCLUSION
Inclusion of clinical indications and patient demographics in assessing the likelihood of malignancy may potentially lead to fewer benign biopsies and false negatives in certain populations, improving the predictive value of BI-RADS assessments in breast MRI.

CLINICAL RELEVANCE/APPLICATION
Clinical indication and personal/family history should be considered when assessing likelihood of malignancy in findings detected on breast MRI, particularly in BI-RADS 3 category.

Breast MRI Reliably Excludes Malignancy in Conventional BI-RADS 0 Cases

PURPOSE
The use of breast MRI as a problem-solving tool in BI-RADS 0 cases has been the subject of controversy. The purpose of this study was to provide empirical data about the diagnostic use of breast MRI for problem-solving in BI-RADS 0 cases.

METHOD AND MATERIALS
In this IRB-approved, single-center study, 687 women prospectively underwent high-resolution, 3D, dynamic contrast-enhanced breast MRI between January 2012 and December 2012. We analyzed 111 consecutive patients (mean age, 51±12 years; range, 20-83 years) categorized as BI-RADS 0. Breast MRI findings were stratified by clinical presentations, conventional imaging findings, and breast density. MRI results were compared to the reference standard, defined as histopathology or an imaging follow-up of at least one year.

RESULTS
One-hundred-eleven patients with BI-RADS 0 conventional imaging findings revealed 30 (27%) mammographic masses, 57 (51.4%) mammographic architectural distortions, 5 (4.5%) mammographic microcalcifications, 17 (15.3%) ultrasound only findings, and two palpable findings without imaging correlates. No cancers were detected in breast cancer ACR category I. There were 15 true-positive, 85 true-negative, 11 false-positive, and zero false-negative breast MRI findings, resulting in a sensitivity, specificity, PPV, and NPV of 100% (95% CI: 78.2-100%), 88.5% (95% CI: 80.4%-94.1%), 57.7% (95% CI: 36.9%-76.7%), and 100% (95% CI: 95.8%-100%). The general rate of malignancy was higher in mass lesions (22.6%, 12 of 53) compared to non-mass lesions (5.2%, 3 of 58). Lesions presenting as mammographic mass or microcalcification had the highest probability for malignancy, followed by architectural distortions. Lesions presenting without mammographic correlate showed the lowest probability of malignancy. Breast density and reasons for referral had no significant influence on diagnostic performance of breast MRI (p>0.05). ROC-analysis revealed an area under the ROC-curve of 0.966 (95% CI 0.913-0.991).

CONCLUSION
Breast MRI reliably excludes malignancy in conventional BI-RADS 0 cases.

Are Incidental Hepatic Lesions on Breast MRI Clinically Significant?

PURPOSE
Incidental hepatic lesions identified on breast MR can be a diagnostic dilemma due to concern for liver metastases or other significant hepatic lesions. The purpose of this study was to identify the incidence and nature of liver lesions seen on breast MR, and determine whether additional imaging or follow up may be
METHOD AND MATERIALS

From 1/1/10-12/31/11, 1664 breast MR studies were performed. The medical records and imaging of all patients were reviewed for the presence of liver lesions, if an accurate diagnosis was made on breast MRI, how often further imaging was recommended, and the final diagnosis upon additional imaging.

RESULTS

Of 1664 breast MRs, incidental hepatic lesions were seen in 207 (12.4%). In 162 MRs (78%) these were reported as circumscribed T2 hyperintense lesions consistent with cysts or hemangiomas. No diagnosis was made on breast MR in 43 cases (21%) and lesions were described as suspicious for metastases in 2 cases (1.0%). Further imaging was recommended in 50/162 patients (31%) with lesions described as cysts or hemangiomas and 29/43 patients (67%) with lesions for which no diagnosis was made. Of these 79 patients, further imaging was performed in 60 patients (76%), 19 patients (24%) did not have subsequent imaging or were lost to follow-up. Further imaging confirmed the diagnosis of a cyst or hemangioma in 53/60 patients (88%), with no lesion identified in 5/60 patients (8%). 2 patients (3%) had lesions that were categorized as indeterminate on MRI but were stable at 1-year follow-up. The 2 patients with hepatic lesions suspicious for metastases both had mildly T2 hyperintense hepatic lesions confirmed as metastases at subsequent imaging. Both patients had locally advanced breast cancer on MR.

CONCLUSION

The majority of incidental liver lesions on breast MR can be classified as cysts or hemangiomas without further imaging. Of patients undergoing further imaging, 96% of patients had benign findings and 3% had lesions characterized as indeterminate but stable on follow up. In 2 cases (1%), T2 mildly hyperintense hepatic lesions were correctly identified as metastases on breast MR. Our series suggests further imaging may not be necessary for incidental benign appearing lesions seen on breast MR.

CLINICAL RELEVANCE/APPLICATION

Breast MR detects incidental liver lesions in 12% of patients, the majority of which are benign. This suggests that additional dedicated hepatic imaging may not be necessary.
RESULTS
Median (interquartile range) overall LVOT and high LVOT/subannular calcium volumes were higher in the rupture group 74 (5-326) mm3 vs. 4 (0-63) mm3 (p<0.0001), and 29 (3-66) mm3 vs. 0 (0-9) mm3 (p=0.002). No difference between groups in aortic valve/sinus of Valsalva calcium volume, 848 (390-1138) mm3 vs. 546 (296-976) mm3 (p=0.09). High LVOT/subannular calcium volume did not predict aortic root injury the non-coronary cusp (AUC: 0.95; 95% CI: 0.82-0.99) compared to calcium eruption the right cusp (AUC: 0.87; 95% CI: 0.79-0.95; p=0.03). Prosthesis oversizing >20% (likelihood ratio test p<0.001) and redilatation (likelihood ratio test p=0.002) significantly improved prediction of root injury by high LVOT/subannular calcium.

CONCLUSION
High LVOT/subannular calcium volume, particularly located below the non-coronary cusp, is more predictive of aortic root rupture than overall LVOT calcium. Prosthesis oversizing >20% and redilatation augments the impact of high LVOT/subannular calcium on the risk of root injury.

CLINICAL RELEVANCE/APPLICATION
These findings may help identify patients at risk of aortic root injury during balloon-expandable TAVR.

SSG02-02
Multicenter Evaluation of Transcatheter Aortic Valve Replacement Using Either SAPIEN XT or CoreValve: Degree of Device Oversizing and Clinical Outcomes


PURPOSE
Data on degree of device oversizing associated with optimal clinical outcomes after transcatheter aortic valve replacement (TAVR) is limited.

METHOD AND MATERIALS
A multicenter analyses of consecutive transfemoral TAVR procedures using either SAPIEN XT or CoreValve was utilized. Oversizing zones were defined for SAPIEN XT (5-20% area oversizing or 2.5-9.5% perimeter oversizing) and for CoreValve (20-35% area oversizing or 9.5-16.2% perimeter oversizing). “favorable-SAPIEN XT” (FXT) zone and “favorable- CoreValve” (FCV) zone included annular sizes for which implantation of either a SAPIEN XT or a CoreValve, respectively, allowed for presumed favorable oversizing.

RESULTS
A total of 368 patients were included in the study: 178 patients in the FCV zone (treated by either CoreValve, n=90 or SAPIEN XT, n=88) and 190 patients in the FXT zone (treated by either SAPIEN XT, n=78, or CoreValve, n=112). In FCV zone, those treated by SAPIEN XT had more annular rupture and conversion to cardiac surgery in comparison with those treated by CoreValve (3.4% vs. 0, p=0.04 and 4.5% vs. 0, p=0.02, respectively). In FXT zone, those treated by CoreValve had more post balloon dilatation and 30-day major stroke in comparison with those treated by SAPIEN XT (16.1% vs. 7.7%, p=0.04 and 8% vs. 1.3%, p=0.02, respectively).

CONCLUSION
Optimal clinical performance of CoreValve and SAPIEN XT appears to be reached with different degrees of device oversizing. An individualized-device-approach during TAVR, utilizing a specific device for a specific annulus size, enabling favorable degree of oversizing, may improve clinical outcomes. This approach should be further validated in future trials.

CLINICAL RELEVANCE/APPLICATION
An individualized-device-approach during TAVR, utilizing a specific device for a specific annulus size, enabling favorable degree of oversizing, may improve clinical outcomes.

Effect of Annular Calcification on Area and Perimeter Measurements in Systole and Diastole: Implications for Device Sizing


PURPOSE
CT based sizing has been shown to reduce paravalvular leak following transcatheter aortic valve replacement (TAVR). However there is conflicting data on the extent of annular dynamism throughout the cardiac cycle. The objective of the current study is to assess the degree of variability of aortic annular measurements in systole and diastole using MDCT and to evaluate the impact on device sizing.

METHOD AND MATERIALS

In this retrospective, multicenter analysis, ECG-gated retrospective CT data of 357 patients were analyzed. Aortic annulus dimensions were assessed on systolic and diastolic reconstructions by planimetry and using a smoothing algorithm not previously described, yielding values for both area and perimeter. Extent of annular calcification was graded using a semi-quantitative 4-point scale (0-3). Hypothetic device sizing was performed by area and perimeter.

RESULTS

There was an overall significant difference between systolic and diastolic reconstructions in both perimeter and area measurements (perimeter 3.52%, p<0.0001; area 7.98%, p > 0.0001), however these measurements lost statistical significance with increasing LVOT calcification (grade 2 and 3 LVOT calcium for both perimeter and area). Diastolic measurements would result in a smaller valve in 82 cases by area and 78 by perimeter with one perimeter case which diastole would recommend a larger valve using Vancouver guidelines for area and Kasel for perimeter.

CONCLUSION

Annular dimensions are subject to dynamic changes throughout the cardiac cycle, resulting in changes to the cross-sectional area, perimeter and subsequently derived diameters. This has implications for accurate valve sizing. The dynamic changes become less significant with increasing calcium burden in the LVOT.

CLINICAL RELEVANCE/APPLICATION

Clinically significant changes in both annular area and perimeter are seen between systolic and diastolic phase cardiac CT imaging acquisitions. Utilisation of diastolic phase images for either perimeter or area derived measurements would result in a change of valve size in a substantial number of patients which could result in increased complications. The change in measured valve parameters appears less significant with increasing LVOT calcification.

SSG02-04

Underestimation of Effective Aortic Orifice Area after TAVR due to LVOT Ellipticity – Impact on Patient-prosthesis Mismatch Classification


PURPOSE

To define the influence of left ventricular outflow tract (LVOT) geometry on calculation of the effective orifice area (eOA) and classification of patient-prosthesis mismatch (PPM) after transcatheter aortic valve replacement (TAVR).

METHOD AND MATERIALS

86 patients (52 male, mean age 82.1±7.6 years, mean BSA 1.9±0.22) status post TAVR underwent both transthoracic echocardiography and contrast enhanced cardiac computed tomography. LVOT dimensions were assessed by means of planimetry on systolic CT reconstructions with subsequent calculation of an area-derived LVOT diameter. EOA was calculated according to the continuity equation, based on transaortic measurements by continuous-wave Doppler and LVOT measurements obtained by pulsed-wave Doppler (EOATTE). In addition, a modified EOA was calculated using the area-based LVOT diameter by CT (EOACT). Moderate and severe PPM were defined as an indexed EOA (iEOA) 0.85 cm2/m2 and 0.65 cm2/m2, respectively. Postprocedural aortic valve area (AVA) was assessed by TEE planimetry.

RESULTS

Mean LVOT diameters were 2.4±0.3mm by TTE and 2.0±0.2mm by CT (p<0.001). Mean EOATTE was significantly lower (1.7±0.4cm2) than EOACT (2.4±0.7cm2, p<0.001). By iEOATTE, 20 patients (29%) were graded as moderate PPM and 4 (6%) as severe PPM. By iEOACT, PPM grade was reclassified in 21 patients, with 4 patients (6%) graded as moderate PPM and no patients (0%) graded as severe PPM. Postprocedural aortic valve area (AVA) was assessed by TEE planimetry.

CONCLUSION

LVOT ellipticity and subsequent underestimation of true LVOT dimensions by TTE results in lower calculated eOA values and high frequencies of estimated PPM after TAVR. Cardiac computed tomography allows for individual correction of the calculated eOA and reclassification of the PPM grade.

CLINICAL RELEVANCE/APPLICATION
Information provided by cardiac computed tomography can be used for individual correction of the calculated eOA and reclassification of the PPM grade.

SSG02-05

Low kV MDCT Angiography for Transcatheter Aortic Valve Implantation (TAVI) Planning: Image Quality and Radiation Dose Exposure

Fabrizio Del Buono MD : Nothing to Disclose , Davide Ippolito MD : Nothing to Disclose , Camillo Roberto Giovanni Leonpoldo Talei Franzesi : Nothing to Disclose , Pietro Andrea Bonaffini MD : Nothing to Disclose , Davide Fior MD (Presenter): Nothing to Disclose , Sandro Sironi MD : Nothing to Disclose

PURPOSE

To evaluate image quality and radiation dose exposure of low-kV (100kV) CT angiography (CTA) in patients candidate to Transcatheter Aortic Heart Valve Implantation (TAVI), in comparison with standard CT angiography protocol.

METHOD AND MATERIALS

A total of 49 patients (18 males; mean age 83.8 years, range 78-90 years), candidate for TAVI, were prospectively enrolled in this study and examined with 256-row scanner (iCT, Philips) with 80mL of iso-osmolar contrast medium volume (350mgI/mL). Twenty-eight patients (group A; 8 males; mean age 83.6 years, range 78-89 years) were evaluated using low-KW (100kV) retrospective ECG-gated protocol, with automated tube current modulation, while 21 patients (group B; 10 male; mean age 84.3 years, range 81-90 years) underwent a standard CTA study (120kV; retrospective ECG-gated protocol; automated tube current modulation). Overall image quality was evaluated using a 4-point scale (4 excellent, 3 good, 2 acceptable, 1 low). Vascular enhancement (HU) was then assessed in each patient by manually drawing on axial arterial images multiple regions of interest (ROIs) in lumen of aortic root, ascending aorta, arch, descending and abdominal aorta, common and external iliac arteries. The radiation dose exposure of both groups, in terms of dose-length product (DLP, mGy*cm), was calculated and all data were compared and statistically analyzed.

RESULTS

On low-kV protocol significant higher mean attenuation values were achieved in all the measurements (aortic root 347+19.78 HU; external iliac arteries 305+18.36 HU) as compared to the standard kV protocol (aortic root 269+23.91 HU; external iliac arteries 226+11.64 HU). There were no significant differences in the image quality evaluation in both groups (groupA 3.7 vs groupB 3.8). Mean DLP of groupA was significantly lower (mean DLP 1600mGy*cm) than in groupB (mean DLP 2044mGy*cm), with an overall radiation dose reduction of 22%.

CONCLUSION

Low-kV CTA protocol permits to correctly perform TAVI planning with high quality images and significant reduction of radiation dose exposure, as compared to standard CTA protocol.

CLINICAL RELEVANCE/APPLICATION

Low-kV CTA may be a valid imaging tool for the pre-operative assessment of thoraco-abdominal aorta and iliac arteries in patients candidate to TAVI, with a reduced radiation dose exposure.

SSG02-06

Computed Tomography Evaluation of Subvalvular Soft Tissue in Patients Who underwent Valve Replacement Surgery during Immediate Postoperative Period

Sangik Park 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

Subvalvular soft tissue (pannus) formation has been known to be a cause of high transvalvular gradient and necessitate reoperation of valvular replacement. There was lack of data regarding the prevalence of subvalvular pannus during immediate postoperative period. This study aimed to evaluate prevalence and hemodynamic significance of subvalvular pannus in computed tomography (CT) during immediate postoperative period in patients who underwent valve replacement surgery.

METHOD AND MATERIALS

During two years, 1057 patients underwent cardiac valve replacement surgery. Among them 203 patients (mean age, 58; 131 men) underwent ECG-gated cardiac CT within 30 days from operation (aortic valve=180, mitral valve=26, tricuspid valve=3, pulmonary valve=1). Presence of subvalvular pannus was evaluated using multiphase cardiac CT images in dedicated workstation. Hemodynamic parameters such as transvalvular pressure gradient and peak velocity of transaortic flow were evaluated using echocardiography and compared them between patient with and without pannus formation. Valve type- and size-matched comparison between pannus and non-pannus groups were done to evaluate the hemodynamic significances of pannus. Geometric profiles of mechanical valves including diameter of valve and opening angle were evaluated.

RESULTS

Subvalvular pannus was identified in 31 of the 210 valves (14.8%). Among them, 30 were in the aortic location, while the other one was in the mitral location. The mean length, maximal thickness, and involvement angle of
Pannus were 11.3 mm ± 4.4, 3.1 mm ± 1.2, and 54.8° ± 19.3, respectively. Echocardiographic measurements of peak velocity (pannus group vs. non-pannus group, 2.4 m/s vs. 2.3 m/s, p=0.665), maximum pressure gradient (24.0 mmHg vs. 22.7 mmHg, p=0.5297), and mean pressure gradient (12.6 mmHg vs. 11.9 mmHg, p=0.4671) across the prosthetic aortic valve did not show a significant difference statistically.

CONCLUSION

Even in immediate postoperative period, subvalvular pannus was not uncommon in this retrospective study group. However, the extent of subvalvular pannus seemed to be small as compared with results of previous study. Patients with subvalvular pannus during immediate postoperative group showed insignificant hemodynamic parameters on echocardiography as compared with non-pannus group.

CLINICAL RELEVANCE/APPLICATION

Cardiac CT was feasible method to demonstrate subvalvular pannus in patients with prosthetic cardiac valve.

Clinical Impact of Valsalva Sinus Distensibility in Aortic Stenosis: Quantification by 256-slice Coronary CT Angiography

Yamato Shimomiya (Presenter): Nothing to Disclose, Michinobu Nagao MD: Research Grant, Bayer AG Research Grant, Koninklijke Philips NV, Satoshi Kawanami MD: Research Grant, Bayer AG Research Grant, Koninklijke Philips NV, Masato Yonezawa: Nothing to Disclose, Yuzo Yamasaki MD: Nothing to Disclose, Hiroshi Honda MD: Nothing to Disclose, Shinya Takarabe RT: Nothing to Disclose, Masatoshi Kondo: Nothing to Disclose, Hiroshi Hama: Nothing to Disclose, Takashi Shirasaka BS: Nothing to Disclose, Masayuki Tachibana: Nothing to Disclose, Yasuhiro Nakamura RT: Nothing to Disclose

PURPOSE

When treating aortic stenosis (AS), accurate aortic valve area (AVA) measurement is critical for appropriate patient selection and successful transcatheter aortic valve implantation. CT could detail the AVA shape and length, but it is limited by motion and calcification artifacts. Therefore, we propose a new objective index to determine the AS severity.

METHOD AND MATERIALS

A total 33 patients (mean age, 78 years) diagnosed with AS who underwent surgical aortic valve replacement and ECG-gated 256-slice coronary CT angiography and echocardiography were retrospectively reviewed. In addition, 12 patients (mean age, 65 years) with no cardiac disease history or coronary stenosis on CT were enrolled as controls. The valsalva sinus distensibility (VD) index was defined the ratio between the Valsalva sinus area (mm²) and the minor axis of aortic annulus (mm) at end-systole using multiplanar reconstructed CT. The volume of valve caps measuring >800 Hounsfield units was designated as the calcium volume (mm³) at end-diastole. Severe AS was defined as an AVA <75 mm².

RESULTS

The VD index was significantly lower in the AS patients than in the controls (34 ± 6 vs. 41 ± 4, p = 0.0005). ROC analysis revealed a 39 optimal VD index for identifying AS patients with a 0.85 C-statistics, 79% sensitivity, and 83% specificity. In 33 patients with AS, the VD index was significantly lower in patients with an AVA <75 mm² than those with an AVA >75 mm² (31 ± 5 vs. 37 ± 7, p < 0.05). There was no significant difference in the calcium volume between the two groups (257 ± 256 mm³ vs. 190 ± 175 mm³). ROC analysis identified a 34 optimal VD index for identifying AS patients with an AVA < 75 mm², 0.75 C-statistics, 78% sensitivity, and 70% specificity.

CONCLUSION

Decreased Valsalva sinus distensibility is a characteristic feature of AS. The VD index may enable an accurate assessment of aortic stenosis in calcified valve caps.

CLINICAL RELEVANCE/APPLICATION

Valsalva sinus distensibility is an objective measurement for AS severity and is useful in therapeutic planning of transcatheter aortic valve implantation.

Accuracy of Semi Automated Workflow in Reconstruction of CT Angiography prior to Transcatheter Aortic Valve Implant

Manuel Belgrano (Presenter): Nothing to Disclose, Alexia Rossi MD: Nothing to Disclose, Antonio Giulio Gennari: Nothing to Disclose, William Toscano MD: Nothing to Disclose, Cristina Cercato: Nothing to Disclose, Maria Assunta Cova MD: Nothing to Disclose

PURPOSE

To evaluate the accuracy of semi-automated reconstruction workflow in the evaluation of CT-angiography of patients candidate to Transcatheter Aortic Valve Implant (TAVI) in comparison with manual reconstruction performed by an experienced radiologist.

METHOD AND MATERIALS

We retrospectively evaluated the whole body CT-angiography of 35 consecutive patients who underwent TAVI procedure comparing the manual measures of aortic root and peripheral vessels with the measures obtained with a semi automated workflow provided on a off line workstation (iNtuition, Terarecon Inc. Santa Clara USA). The reconstruction time within the two groups was registered.

RESULTS

A good correlation between the two methods (P > 0.05) was observed. The reconstruction time was significantly
lower (P < 0.05) with the automated workflow.

**CONCLUSION**
The semi-automated reconstruction workflow for TAVI patients is accurate and reliable and simplify a complex procedure in easy small steps, significantly reducing the post processing time.

**CLINICAL RELEVANCE/APPLICATION**
The semi automated reconstruction workflow allows to optimize the clinical management of the TAVI patients, reducing the post processing complexity and the reconstruction time.

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**SSG02-09**

**Use of Computed Tomographic Angiography to Determine Extent of Danger Zone for Phrenic Nerve Injury during Left Atrial Ablation Therapy**

Benoit Desjardins MD, PhD (Presenter): Nothing to Disclose, Fabien Squara MD: Nothing to Disclose, Greg Supple MD: Nothing to Disclose, Francis Marchlinski MD: Nothing to Disclose

**PURPOSE**
A complication of left atrial ablation therapy for atrial fibrillation is injury to the right phrenic nerve (RPN). The location of the RPN is estimated during the ablation procedure by attempted electrical excitation of the RPN from multiple locations inside the left atrium. Locations where excitations are captured by the RPN are assumed to be in close proximity to the path of the RPN. This determines a danger zone where ablation lesions are at risk of causing RNP injury. The purpose of this project is to determine the size of this danger zone from Computed Tomographic Angiography (CTA) datasets.

**METHOD AND MATERIALS**
In 19 consecutive patients undergoing left atrial ablation therapy, the path of the RPN was estimated by electrical excitation of the RPN at 10mA and 50mA from different points at the endocardial surface the left atrium. Palpation of diaphragm contraction was used to determine whether there was capture or non-capture of the excitation by the RPN. After the procedure, the 3D path of the RPN was identified and segmented from CTA datasets using either visualization of the RPN or the right pericardiophrenic artery. The segmented RPN was then merged with the cardiac ablation dataset, and minimal distance of each electrical excitation site to the path of the RPN was determined and correlated with capture or non-capture of each electrical excitation by the RPN.

**RESULTS**
The mean distance between the RPN and the electrical excitation sites at 50mA was 15.5 ± 5.9mm for captured sites vs. 19.0 ± 7.2mm for non-capture sites (p

**CONCLUSION**
There is good correlation between minimal distance between the left atrial electrical excitation site and the RPN and capture versus non-capture of the electrical excitation by the RPN. This data helps determine the size of the danger zone around the path of the RPN where ablation lesions at different intensities are at risk of affecting the RPN and causing possible injury.

**CLINICAL RELEVANCE/APPLICATION**
CTA is often performed before ablation therapy to assess pulmonary vein anatomy. In addition, radiologists can also identify the path of the RPN from CTA datasets, and use this information to describe the extent of a danger zone around which ablation lesions could injure the RPN.

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**SSG03**

**Emergency Radiology (Abdominal Emergencies)**

**Scientific Papers**

**SSG02-09**

**Rapid Acquisition Axial and Coronal T2 HASTE MR in the Evaluation of Acute Abdominal Pain**

Sam Byott MBChB (Presenter): Nothing to Disclose, Ian Harris MBChB, FRCR: Nothing to Disclose

**PURPOSE**
To assess MR in acute abdominal imaging and ascertain if it is a reliable alternative to CT in patients under 60
METHOD AND MATERIALS

Four year prospective analysis from January 2009 - December 2013. In patients under 60 presenting with acute abdominal pain, MR was used either as a primary investigation, or following ultrasound when there was ongoing clinical concern. Rapid acquisition HASTE (Half Fourier Acquisition Single Shot Turbo Spin Echo) coronal and axial sequences without intravenous contrast. Patients were followed up for minimum of 3 months.

RESULTS

468 cases included in the study. 349 negative for acute abdominal pathology 116 positive for acute abdominal pathology 3 indeterminate

MR Negative:
324 had uneventful follow up 22 had negative laparoscopies 3 had subsequent appendectomies, appendicitis on histology (3 days, 10 days and 2 months post scan)

MR Positive:
64 had surgery confirming MR findings: 34 appendicitis, 14 SBO, 3 Ovarian torsion, 3 LBO, Intussusception, Ovarian carcinoma, Ovarian dermoid, 2 Pelvic inflammatory disease, Diverticular abscess, Crohns, 4 Endoscopy for acute bowel pathology 1 had surgery for MR diagnosis of appendicitis, sigmoid diverticular perforation identified at surgery 51 were treated conservatively with concordant follow-up: 4 SBO, 11 diverticulitis, 6 Pelvic inflammatory disease, 7 Colitis, 6 Pyelonephritis, 2 Cholecystitis, Renal abscess, Pseudomembranous colitis, Splenic haematoma, Mesenteric adenitis, 2 Pancreatitis, Lymphoma, Epiploic appendagitis

MR indeterminate:
1 treated conservatively, 1 had laparoscopic appendectomy, normal appendix on histology, 1 had laparoscopic appendectomy with acute appendicitis on histology

Overall diagnostic accuracy of 99% (463/468), with respect to correlation between MR diagnosis and clinical/surgical follow up

Negative laparoscopy rate: 4.9%

CONCLUSION

This study demonstrates that rapid acquisition axial and coronal T2 HASTE MR is a practical, safe and effective method in the diagnosis of acute abdominal pain. MR is the preferred option to CT in patients of an age prone to radiation with a potential surgical diagnosis.

CLINICAL RELEVANCE/APPLICATION

MRI in acute abdominal imaging is both effective and practical and is the preferred imaging option in patients of an age prone to radiation with a potential surgical diagnosis.

Ureteral Stone Detection Using Virtual Nonenhanced Images in Enhanced Spectral CT Imaging: A Preliminary Study


PURPOSE

To evaluate the clinical value of detecting ureteral stones with the virtual nonenhanced (VNE) images generated in the enhanced spectral CT imaging.

METHOD AND MATERIALS

38 adults (21 males and 17 female, ages: 24-76 years) with positive calculi in the urinary system found during abdominal CT for lesion diagnosis or clinical emergency were retrospectively analyzed. True nonenhanced (TNE) CT was performed with 120kVp with noise index of 12 at 5mm slice thickness. Contrast-enhanced scans in the venous phase (VP) and delayed phase (DP) were performed with spectral CT mode. VNE images were generated from the 2 enhanced phases. 2 board-certified radiologists reviewed both TNE and VNE images for image quality and stone detection rate. Mean CT number, size and contrast-noise-ratio (CNR) of stones were measured.

RESULTS

52 stones were detected from TNE images, including 11 in the renal parenchyma, 25 in the renal pelvices, 4 in the ureters of abdominal segments, 7 in the ureters of pelvis segments and 5 in the bladder; 51 and 52 stones were detected with VNE images at VP and DP, respectively. The missed stone at VP located in renal parenchyma with diameter less than 0.8mm and low CT number of 86HU, similar to that of renal parenchyma. The mean CT number (in HU) for the stones from TNE was 310.15±154.85, higher than the 244.33±153.20 from VNE at VP and 251.78±155.73 at DP (p<0.05). The maximum stone areas (in mm2) determined from VNE images were 39.0±32.7 and 38.8±33.4, within 83% of the 47.0±36.8 determined by TNE images. The 3 sets images produced similar image quality scores and CNR values at 22.51±12.99, 19.25±15.69 and 20.91±17.71, respectively with no difference. The dose reduction achieved by omitting TNE scan was 21.4%.

CONCLUSION

The use of VNE images generated from the enhanced spectral CT provides very high sensitivity in detecting ureteral stones with good image quality and 21% dose reduction compared with the TNE images. There is good correlation in stone CT number and size measurement between TNE and VNE images.

CLINICAL RELEVANCE/APPLICATION

VNE images from enhance spectral CT may be used to replace TNE for ureteral stone detection with excellent sensitivity and dose reduction.

Direct Comparison of Contrast-Enhanced MRI with Contrast-Enhanced CT to Diagnose Appendicitis
SSG03-04

Usefulness of Low-Dose Non-enhanced CT with Coronal Reformations in Patients with Suspected Acute Appendicitis: Comparison with Standard-Dose Non-enhanced CT


PURPOSE

To evaluate usefulness of low-dose (LD) non-enhanced CT (NECT) with coronal reformation to diagnose acute appendicitis in comparison with standard-dose (SD) NECT and SD contrast-enhanced CT (CECT).

METHOD AND MATERIALS

The institutional review board approved this retrospective study and waived the informed consent. This study population included 452 adult patients (age range, 18-89 years) who underwent CT performed by using a SD (SD NECT and SD CECT1, n = 182) or a LD protocols (LD NECT and SD CECT2, n = 270) for suspected acute appendicitis. Two reviewers independently interpreted the axial and the coronal reformatted images of NECT and CECT scans during separate sessions. They assessed appendix visualization and proposed a diagnosis of appendicitis using a 4-point scale. Diagnostic performance and interobserver agreement for diagnosing acute appendicitis were compared between SD NECT and SD CECT1, LD NECT and SD CECT2, and LD NECT and SD CECT1, respectively.

RESULTS

The frequencies of appendix visualization of reviewers 1 and 2 were 95.6% (174/182) and 94.5% (172/182), 98.4% (179/182) and 98.9% (180/182), 90.7% (245/270) and 90% (243/270), and 98.9% (267/270) and 98.9% (265/270), respectively. Areas under the curves (AUCs) of reviewers 1 and 2 for SD NECT (0.97 and 0.96) were not significantly lower than those of SD CECT1 (0.99 and 0.97) (P = 0.19 and 0.64, respectively). AUCs of reviewers 1 and 2 for LD NECT (0.95 and 0.95) were significantly lower than those of SD CECT2 (0.99 and 0.98) (P = 0.002 and 0.02, respectively). However, AUCs of reviewers 1 and 2 for LD NECT (0.95 and 0.95) were not significantly lower than those of SD NECT (0.97 and 0.96) (P = 0.18 and 0.92, respectively). All of the values for interobserver agreement of SD NECT, SD CECT1, LD NECT, and SD CECT2 were excellent (k = 0.84, 0.84, 0.85, and 0.86, respectively).
CONCLUSION

LD NECT with coronal reformation was not inferior to SD NECT for the initial evaluation of acute appendicitis.

CLINICAL RELEVANCE/APPLICATION

LD NECT can be used as the first-line imaging tool in the workup of patients with suspected acute appendicitis.

SSG03-05

CT Features of Small Bowel Closed Loop Obstruction in Emergency Room: Comparison between Patients Groups according to Treatment Strategies

Cherry Kim MD (Presenter): Nothing to Disclose, Choong Wook Lee MD: Nothing to Disclose, Mi-Hyun Kim: Nothing to Disclose, Gil-Sun Hong MD: Nothing to Disclose

PURPOSE

To assess CT features of small bowel closed loop obstruction (CLO) in patients who need emergency operation within 24 hours, and to compare CT features between patients who need delayed operation and who were recovered by conservative treatment.

METHOD AND MATERIALS

From 2009 to 2013, 187 patients were diagnosed as having CLO based on CT results in the emergency room (ER). Among them, 135 patients were enrolled using the exclusion criteria as follows; (a) CLO by peritoneal seeding, (b) CT images without coronal images, and (c) patients who were immediately transferred to other hospital. Clinical decision for treatment strategy was made based on both clinical and CT findings: 51 patients (Group A) were treated surgically within 24 hours and the remaining 84 patients (Group B) were initially decided to be conservatively treated. Among the 84 patients, 27 patients (Subgroup B1) underwent operation after 24 hours due to aggravation of clinical signs, and 57 patients (Subgroup B2) were recovered with conservative treatment only. CT images were analyzed regarding CT features as follows; pre-contrast bowel wall (BW) attenuation, BW enhancement, BW thickening, mesenteric edema, whirling sign, shape of entrapped mesenteric vessels, distance between beaked bowel loops, mesenteric vascular collapseness, and vascular enhancement of mesenteric arteries and veins. CT features were compared between group A and B, and between subgroup B1 and B2 using Fishers exact test and Student t-test.

RESULTS

CT features of group A showed significantly increased pre-contrast BW attenuation, decreased BW enhancement, decreased vascular enhancement of mesenteric arteries and veins, increased BW thickening, severe mesenteric edema and severe mesenteric vascular collapseness than those of group B (all, p<0.001). In subgroup analysis between B1 and B2, all CT features didn't show any significant differences (all, p>0.05).

CONCLUSION

In patients who admitted ER with CLO, CT features were quite different between the groups who need emergency operation or not. However, there were no significant CT findings to differentiate the patients who need delayed operation from the patients who were completely recovered with conservative treatment.

CLINICAL RELEVANCE/APPLICATION

In patients with small bowel closed loop obstruction, some CT features could be important factors for clinical decision about emergency operation or initial conservative treatment.

SSG03-06

Virtual Monochromatic Reconstruction of Contrast-enhanced Dual-energy CT at 70 keV Maximizes the Conspicuity of Mucosal Enhancement in Acute Small Intestinal Obstruction

Kathryn Darras MD (Presenter): Nothing to Disclose, Patrick McLaughlin FFR(RCSI): Nothing to Disclose, David M. Thomas BSC: Nothing to Disclose, Shamir Rai BSC: Nothing to Disclose, Luck Jan-Luck Louis MD: Nothing to Disclose, Tim O’Connell MD, Meng: President, Resolve Radiologic Ltd, Silvia D. Chang MD: Nothing to Disclose, Alison Clare Harris MBChB: Nothing to Disclose, Savvas Nicolaou MD: Nothing to Disclose

PURPOSE

To evaluate the role of virtual monochromatic imaging (VMI) to maximize the conspicuity of mucosal enhancement in computed tomography (CT) of the abdomen and pelvis for acute small intestinal obstruction and to compare this technique to conventional polychromatic imaging (PCI).

METHOD AND MATERIALS

Institutional review board approval was obtained, with no informed consent required, for this retrospective analysis. 20 consecutive patients with acute small intestinal obstruction were scanned using a 128-section dual source, dual energy CT system using a standardized protocol (100-140 kV, ref mAs of 115-89, 32x0.6mm). Scans were retrospectively reconstructed at VMI energy levels from 40 - 150 keV in 10 keV increments and were analyzed both quantitatively and qualitatively. SNR and CNR values for mucosal enhancement in collapsed segments were recorded using region of interest (ROI) analysis at each energy level for all VMI datasets and
compared to PCI. Subjective analysis of mucosal enhancement was performed by two independent, blinded readers.

RESULTS

The SNR and CNR for mucosal enhancement at the different VMI levels were compared using ANOVA with posthoc analysis with Newman-Keuls Multiple Comparison Test, demonstrating statistical significance (p < 0.05). Optimal SNR and CNR for small intestinal mucosal enhancement was observed at 80 keV and 70 keV, respectively. Qualitatively, both readers reported increased conspicuity of mucosal enhancement at the 70 keV level.

CONCLUSION

VMI reconstruction of contrast enhanced dual energy CT scans of the abdomen and pelvis at 70 keV maximizes the conspicuity of mucosal enhancement in computed tomography (CT) of the abdomen and pelvis for acute small intestinal obstruction. At this level, conspicuity was improved for all readers.

CLINICAL RELEVANCE/APPLICATION

VMI reconstruction of contrast enhanced dual energy CT scans of the abdomen and pelvis at 70 keV maximizes the conspicuity of mucosal enhancement in acute small intestinal obstruction.

SSG03-07  
Usability of Ultrasound for the Diagnosis of Acute Appendicitis Correlated to Patients BMI and the Severity of Inflammation

Sebastian Bickelhaupt (Presenter): Nothing to Disclose, Sandra Tschirky: Nothing to Disclose, Michael A. Patak MD: Nothing to Disclose

PURPOSE

The clinical diagnosis of acute appendicitis in emergency departments is often backed by ultrasound (US) or/and computed tomography (CT). US is commonly the initial modality as an inexpensive and fast tool avoiding ionizing radiation. The increasing number of patients with a high body mass index (BMI) might limit the use of US. Our study investigated the accuracy of US for the diagnosis of appendicitis correlated to the patients BMI, the severity of inflammation and the need for additional CT-examinations.

METHOD AND MATERIALS

716 patients with suspected acute appendicitis (mean age 40.33, 309 female, 408 male) were included in this IRB-approved, retrospective study between 2005-2011. Inclusion criteria: clinically suspected acute appendicitis, data of body mass index (BMI), leukocytes, c-reactive protein and a consecutive surgical intervention with histopathologically proven appendicitis. Patients grouping followed WHO definitions (BMI<18.5; 18.5-24.9; 25.0-29.9; >30). Correlations between the BMI, ultrasound-ability in detecting acute appendicitis, the necessity for CT examinations (Siemens Somatom 64, Erlangen, Germany) and the level of inflammation were calculated using Spearman's rank-correlation.

RESULTS

Ultrasound-usage decreased with increasing BMI from 65.5% (BMI<18.5) and 67.11% (18.5-24.9) to 54.6% (25.0-29.9) and 45.6% (>30) in a significant negative correlation (r=-0.1, p=0.006). Vice versa initial CT usage increased from 7.82% to 18.5% (r=0.2, p<0.05). The need for additional CT after US significantly correlated with the BMI (r=-0.1, p=0.005) (3.4%; 10.7%; 11.6%; 26.5%). The diagnostic certainty of ultrasound significantly decreased with increasing BMI from 48.27% and 45.8% to 38% and 30.8% (r=-0.097, p=0.006), that did not correlate with levels of inflammatory markers (p>0.05) which did not differ between the groups.

CONCLUSION

The diagnostic certainty for the diagnosis of acute appendicitis significantly correlates with the BMI of the patients, leading to an increasing need for additional CT in obese patients. This finding was independent of the severity of inflammation with no correlation between the level of inflammatory markers and the diagnostic certainty of the ultrasound examination.

CLINICAL RELEVANCE/APPLICATION

Our study revealed a significant and robust negative correlation between the diagnostic certainty and an increasing BMI in the patients which helps to assess the appropriateness of initial ultrasound in patients depending on the BMI.

SSG03-08  
Evaluation of the Distribution of Enteral Contrast in ED Patients Undergoing Abdominal-Pelvic CT: Does It Get Where It Is Supposed to Go and What Is the Added Value?


PURPOSE

Current oral prep for adult abdominal-pelvic CT (AP CT) has shortened to one hour to facilitate faster Emergency Department (ED) patient care. How often does oral contrast optimally opacify the gastrointestinal
tract? Does this contrast reach the site of pathology or assist in diagnosis?

**METHOD AND MATERIALS**

All adults undergoing AP CT exams in the ED at two university-affiliated urban hospitals were identified via the healthcare database over a 3-month period in 2012. Two raters reviewed CTs for the proximal and distal location of enteric contrast. Presence, site, and type of bowel pathology as well as prior gastrointestinal surgery were documented. When applicable, the site of bowel pathology was evaluated for the presence or absence of enteric contrast.

**RESULTS**

Of 1349 patients, 530 (39%; 61% female, mean age 50+/- 19 years) were administered oral contrast. In 321/530 (61%), oral contrast reached the terminal ileum (TI). Bowel pathology was present in 31% of these cases (165/530). When small or large bowel pathology was present, 47% (77/165) of cases had oral contrast present at the bowel pathology site. When the bowel was categorized into 4 anatomic segments, there was a significant difference (p<0.001) in oral contrast reaching the site of bowel pathology based on location: stomach and duodenum (84%), jejunum to TI (35%), proximal colon (57%), and distal colon (28%). In 8% of cases (41/530), the original interpretation was equivocal for bowel pathology. 59% (24/41) of these equivocal cases had oral contrast present at the site of pathology. Of all 530 oral contrast cases, in only 84 cases (16%) did contrast extend from the stomach to the distal colon.

**CONCLUSION**

Only 61% of adults in the ED that undergo CT achieve oral contrast passage to the TI. 16% had complete stomach to distal colon contrast distribution. Oral contrast was present at the possible pathology site in equivocal reports (59%) in a similar frequency to positive cases (47%). These results raise questions about the use of oral contrast to facilitate identification and characterization of bowel pathology, unless prep time is lengthened.

**CLINICAL RELEVANCE/APPLICATION**

ED length of stay time pressures continue to intensify, leading to shorter prep times for oral contrast administration. As a result, optimal CT bowel prep is not achieved in many patients.

**A New Technique for the Diagnosis of Acute Appendicitis: Abdominal CT with Compression to the Right Lower Quadrant**

Erhan Akpinar MD : Nothing to Disclose, Abidin Kilincer MD (Presenter): Nothing to Disclose, Bulent Erbil : Nothing to Disclose, Volkan Kaynaroglu : Nothing to Disclose, Deniz Akata MD : Nothing to Disclose, Mustafa Nasuh Ozmen MD : Nothing to Disclose

**PURPOSE**

To determine the diagnostic accuracy of abdominal CT with compression to right lower quadrant in adults with acute appendicitis.

**METHOD AND MATERIALS**

Institutional review board approved this prospective study, and compression group patients gave written informed consent. The study included 168 patients (age range, 18-78 years) who underwent contrast enhanced CT for suspected appendicitis performed either by using compression to the RLQ (n = 71) or by standard protocol (n = 97). Compression was applied to RLQ with 1000cc saline bag and an elastic belt. All compression group patients had abdominal US examination before CT to exclude conditions like abdominal aortic aneurysm, etc. Two radiologists reviewed in consensus CT images; receiver operating characteristic (ROC) analysis, Fisher exact tests, and Mann-Whitney U tests were used to compare diagnostic accuracy between the two groups.

**RESULTS**

Fifty-nine patients (23 in compression group and 36 in standard protocol) had pathologically proven acute appendicitis. Median (min-max) outer diameter of appendix was 10 mm (7-15 mm), 10.5 mm (7.1-17.6 mm), 5 mm (4-7.5 mm) and 6.3 mm (4.8-10.3 mm) among patients with appendicitis in compression and standard-CT, and without appendicitis in compression and standard-CT, respectively. While appendix diameter was not significantly different among patients with appendicitis undergoing CT with or without compression, there was a significant difference across other groups in pairwise comparisons (p<0.01). In patients without appendicitis, filling of contrast material to the appendiceal lumen was statistically higher in compression group when compared to standard protocol (p<0.01). Area under the ROC curve of compression and standard CT were 0.997 and 0.979, respectively. Using a cut-off value of 6.75 mm for outer appendiceal diameter, the sensitivity and specificity for diagnosing appendicitis was 100% and 67.3% with standard CT, while the specificity increased to 94.9% with preservation of sensitivity at 100% with compression CT.

**CONCLUSION**

Normal appendix diameter was significantly smaller in compression-CT group when compared to standard-CT group, increasing the diagnostic accuracy of CT performed by abdominal compression.

**CLINICAL RELEVANCE/APPLICATION**

Abdominal CT with compression to right lower quadrant, which can be considered as a CT counterpart of graded compression US, has a high diagnostic accuracy in the setting of acute appendicitis.
SSG04

Gastrointestinal (CT Dose Reduction I)

Scientific Papers

SSG04-01

Achieving Sub-millSievert Radiation Dose: Prospective Randomized Clinical Study to Assess Ultra-low Dose Abdominal MDCT with a Three Dimensional Adaptive Iterative Reconstruction (AIDR) and Image-based Iterative Reconstruction (SafeCT)


PURPOSE

To assess ultra-low dose (ULD) abdominal MDCT using a three-dimensional adaptive iterative reconstruction (AIDR-3D) and SafeCT, an image-based vendor-neutral iterative reconstruction (IR) compared with standard-dose imaging.

METHOD AND MATERIALS

A total of 36 patients (mean age 66±12 years; M:F 19:17; mean weight 71±15 kg) gave informed consent for this prospective clinical study and underwent abdominal CT on 320 MDCT (AquillionONE, Toshiba Healthcare). Two consecutive image series were acquired in each patient: (i) standard-of-care (SD) CT [6mSv, mean CTDI vol 8 mGy] and (ii) ULD-CT (0.9mSv, 2.5 mGy). Scan length of ULD-CT was half that of SD-CT (lung bases to mid-abdomen). SD-CT and ULD data were reconstructed with FBP, SafeCT (MediciVision Israel) and AIDR-3D resulting in 360 image series. Two radiologists independently assessed subjective quality using a task-based evaluation to assess organ-based focal lesions and normal anatomical structures (when no lesions were present). Image noise was measured at homogenous liver parenchyma. Noise-spectral density plots were obtained. Student’s t-test and ANOVA were used on SPSS v 22.0.

RESULTS

Mean dose reduction relative to SD CT was 75%. Radiologists identified 173 focal lesions with SD-FBP. Lesion detection for ULD-CT images was 79% (139/176; most lesion being missed in patients weighing ≥75kg 37% missed 50/79). ULD-FBP images were clinically inadequate for all abdominal structures. Mean subjective image quality score for ULD-IRT images was significantly higher in patients weighing <75kg (p<.01). For liver margins and parenchyma, ULD-AIDR3D and ULD-SafeCT images were significantly better than ULD-FBP images (p<0.01). Visualization of low-contrast hepatic and renal lesions was clinically adequate on both ULD-AIDR3D and ULD-SafeCT images compared to ULD-FBP (p<0.01). Mean liver image noise for ULD-AIDR3D was 17HU, significantly lower than SD-FBP (22, p=.009), ULD-FBP (60HU, p<.001) and ULD-SafeCT (26HU, p=.003). Although image quality of SD images were significantly better than ULD, lesion detection was deemed acceptable on ULD scans reconstructed with IR techniques (p<.01).

CONCLUSION

Iterative reconstruction techniques (such as 3-dimensional AIDR and SafeCT) show great potential for substantially reducing radiation dose of abdominal MDCT.

CLINICAL RELEVANCE/APPLICATION

Abdominal MDCT is achievable at 2.5 mGy (~0.9mSv) using 3D-AIDR and image-based SafeCT without significant compromise in image quality at 75% dose reduction.

SSG04-02

Comparison of Image Based, Adaptive Statistical, and Model Based Iterative Reconstruction Techniques for Substantial Dose Reduction for Abdominal CT

Atul Padole MD (Presenter): Nothing to Disclose, Garry Choy MD, MS: Nothing to Disclose, Diego Alfonso Lira MD: Nothing to Disclose, Ranish Deedar Ali Khawaja MD: Nothing to Disclose, Sarabjeet Singh MD: Research Grant, Siemens AG Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV, Mannudeep K. S. Kalra MD: Nothing to Disclose, Alexi Otrakji MD: Nothing to Disclose, Roberto Lo Gullo MD: Nothing to Disclose, Saryenaz...
**PURPOSE**

To evaluate low dose abdominal CT images reconstructed with image-based (SafeCT), adaptive statistical (ASIR), and model-based (MBIR) iterative reconstruction techniques to the standard dose abdomen CT.

**METHOD AND MATERIALS**

In an IRB approved, prospective clinical study included 21 patients (mean age 68 ± 7 years, mean weight 82±15 kg, M:F 14:7, undergoing routine abdomen CT on a 64 channel MDCT (Discovery CT750 HD). After standard of care abdominal CT, low dose images were acquired at 120 kV and reduced mAs (CTD1vol of 2.5 mGy). Sinogram data of low dose series were reconstructed with SafeCT (AP0, AP1), ASIR (SS70, SS90 GE Healthcare) and MBIR (GE Healthcare) and standard dose abdomen CT reconstructed with ASIR (SS50) (n = 6*21=126 series). Two radiologists performed independent and blinded comparison for lesion detection, lesion conspicuity, and visibility of small structures, first for all patients with low dose images and subsequently for standard dose images.

**RESULTS**

Mean CTD1vol were 13 ± 1.7 and 2.5 ± 0.1 mGy for standard and low dose abdominal CT, respectively. There were two missed lesions (small liver cyst and kidney cyst) on low dose images. Pancreatic ducts could be seen in only 5/10 patients at low dose regardless of iterative reconstruction techniques. The lesion conspicuity (23/25 lesions) was sufficient for clinical diagnostic performance for low dose SafeCT, ASIR and MBIR images. Low dose MBIR had limited diagnostic performance for evaluation of liver and kidney parenchyma in 18/21 patients compared to 8/21 for SafeCT and 7/21 for ASIR images. The liver margin, adrenal glands, pancreatic contour, gall bladder, peritoneum, retroperitoneum, and bowels were sufficient and equally seen on all low dose images regardless of iterative reconstruction techniques.

**CONCLUSION**

Low dose abdominal CT at 2.5 mGy is sufficient for most clinically significant lesions with SafeCT, ASIR, and MBIR. However, evaluation of pancreas requires higher dose than 2.5 mGy. Visibility of normal liver parenchyma is limited on low dose MBIR images.

**CLINICAL RELEVANCE/APPLICATION**

Iterative reconstruction techniques can allow sufficient clinical diagnostic performance for routine abdominal CT image at CTD1vol of 2.5 mGy.

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**SSG04-03**

**CT Imaging of the Liver: Comparison of Sinogram-affirmed with Advanced Modeled Iterative Reconstructions**

Fabian Morsbach (Presenter): Nothing to Disclose, Lotus May Desbiolles MD: Nothing to Disclose, Sebastian Leschka MD: Nothing to Disclose, Hatem Alkadhi MD: Nothing to Disclose

**PURPOSE**

To investigate image quality and conspicuity of liver lesions on abdominal computed tomography (CT) images, reconstructed with advanced modeled iterative reconstruction (ADMIRE), sinogram-affirmed IR (SAFIRE) and filtered back projection (FBP).

**METHOD AND MATERIALS**

Forty patients (19 female, mean age 63±14 years) with focal liver lesions (cysts, n=16; hemangiomas, n=6; metastases, n=18) undergoing standard portalvenous phase abdominal CT were included. Images were reconstructed with ADMIRE (strength levels 1-5), SAFIRE (strength levels 1-5), and FBP at a slice thicknesses of 2 mm. Two readers evaluated subjective image quality focusing on image appearance (score 1: no artifacts, 2: minor artifacts, blotchy, plastic-like appearance, 3: major artifacts, blotchy, plastic-like appearance, 4: artifacts making a diagnosis impossible), and visibility of small structures (score 1: excellent visibility, 2: above average, 3: average, 4: poor). Readers also rated the conspicuity of lesions (score 1: well-seen lesion, well delineated margin, score 2: well-seen lesion, poorly delineated margin, score 3: subtle lesions, score 4: probably an artifact mimicking a lesion). Attenuation (in HU) of the liver and subcutaneous fat and the standard deviation of attenuation indicating noise was measured. Friedman test and analysis of variance (ANOVA) were conducted.

**RESULTS**

Readers found a significantly improved image appearance for all strength levels of ADMIRE compared to the respective SAFIRE levels (P<0.001), as well as superior visibility of small structures (P<0.001). Lesion conspicuity was rated similarly with ADMIRE and SAFIRE (P>0.05) and superior to FBP at strength levels 3-5 (all, P<0.05). HU-values of the liver and fat did not vary with reconstruction algorithms (P>0.05). Noise decreased with increasing strength levels compared to FBP (P<0.05), with no differences among corresponding strength levels (P>0.05).

**CONCLUSION**

As compared to SAFIRE, ADMIRE improves image quality and reduces artificial image appearance at a similar noise reduction level without impairing lesion conspicuity.

**CLINICAL RELEVANCE/APPLICATION**
Iterative reconstructions with a less artificial image appearance can be used for CT imaging at low radiation doses with a broader acceptance by radiologists in daily clinical routine.

**SSG04-04**

**Differences of Radiation Dose Estimates Compared with Direct Measurements in Morbidly Obese Patients undergoing Abdominal Computed Tomography: An Experimental Ex-Vivo and Patient-based Study**

Roy Marcus MD (Presenter): Nothing to Disclose, Fabian Bamberg MD, MPH: Speakers Bureau, Bayer AG
Speakers Bureau, Siemens AG Research Grant, Bayer AG Research Grant, Siemens AG, Klement Neumaier: Nothing to Disclose, Maximillian F. Reiser MD: Nothing to Disclose, Konstantin Nikolaou MD: Speakers Bureau, Siemens AG, Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Thorsten R. C. Johnson MD: Nothing to Disclose

**PURPOSE**

Proper CT imaging of morbidly obese patients remains an imaging challenge. The necessary increase in tube voltage and current results in dose length products (DLP) with high extrapolated effective dose estimates. However, actual equivalent dose exposition is presumably lower as an effect of the shielding of the adipose tissue layer. Thus, the aim of this study was to assess the association between conventionally estimated and measured radiation dose in morbidly obese patients.

**METHOD AND MATERIALS**

The study consisted of an ex- and an in-vivo part. In the ex-vivo experiment, an Alderson Phantom was equipped with 108 thermo-luminescent detectors (TLD) throughout the lower chest, the abdomen and pelvis and scanned on a Dual Source CT (DSCT): (I) Slim phantom with automatic potential and current modulation and (II) Obese phantom embedded in a circumferential 30 cm layer of pork fat, simulating a patient with a BMI>35, with 2x140kVp and current modulation. In the in-vivo study, 7 patients (BMI > 35) referred for abdominal imaging were scanned on a DSCT with 2x120kVp and automatic current modulation. Effective dose was derived according to IRCP-103 (TLD ex-vivo), based on DLP with standard conversion factor k (DLP-based; ex and in-vivo), and using a Monte-Carlo-Simulation (MCS; ex- and in-vivo).

**RESULTS**

TLD, MCS and DLP based dose values did not show any differences in the ex-vivo setting simulating lean body habitus (I: 3 vs. 3.2 vs. 3 mSv). In the ex-vivo setting simulating obese body habitus (II), TLD and MCS based values did not show a significant difference; however, both were significantly lower than DLP-based value (9.52 vs. 11.6 vs. 34.2 mSv, p

**CONCLUSION**

Our results indicate that estimated and measured radiation dose in obese patients undergoing CT differs significantly with falsely documented high dose estimates in this population (up to 4-fold). Thus, a weight adapted k value of 0.0055-0.0075 for such patients may provide more accurate effective dose estimates.

**CLINICAL RELEVANCE/APPLICATION**

Currently reported dose values in obese patients undergoing CT do not provide adequate estimates of radiation dose and should be evaluated carefully.

**SSG04-05**

**Risk of Cancer Associated with Radiation in Torso CT Scan: A Hospital-based Comparative Study across Different Types of Scanners**

Omid Khalilzadeh MD, MPH (Presenter): Nothing to Disclose, Irene Si Ming Wang MD: Nothing to Disclose, Emad Ahmadi MD: Nothing to Disclose, Sarabjeet Singh MD: Research Grant, Siemens AG Research Grant, Toshiba Corporation Research Grant, General Electric Company Research Grant, Koninklijke Philips NV, Rajiv Gupta PhD, MD: Nothing to Disclose, Mannudeep K. S. Kaira MD: Nothing to Disclose, Synho Do PhD: Research Grant, Koninklijke Philips NV

**PURPOSE**

Radiation exposure from CT can be reduced by use of advanced CT scanners (for example, devices with advanced reconstruction algorithms (ARA), compared with conventional filtered pack projection). Radiation exposure is associated with increased lifetime attributable risk (LAR) of cancer incidence in the sensitive organs. The aim of this study was to evaluate the organ-specific risk of cancer associated with Torso CT scan in patients referred to our institution and compare these across different scanners, and protocols.

**METHOD AND MATERIALS**

Data from 7345 adult patients who underwent chest CT scan, and 8283 patients who underwent abdominal/pelvic CT scan, over a period of 4 months, were retrospectively analyzed. Radiation exposure data was obtained from a radiation-dose analytic software that calculates organ-specific effective doses for each patient. The Biological Effects of Ionizing Radiation (BEIRVII) models were used to extrapolate the LAR of cancer incidence associated with CT radiation. Data was stratified by the anatomic area imaged, machine make (General Electric, Philips, and Siemens), model, reconstruction algorithms and the technologies used in the device. The overall and organ-specific LAR of cancer associated with CT radiation was compared between different groups.

**RESULTS**

For an abdomen/pelvic CT, the LAR of cancer incidence associated with radiation was, on average, highest for kidneys (38.20±0.62, per 100,000) and gall bladder (33.10±0.55 per 100,000). About 30% of patients with abdomen/pelvic CT, and 36% of patients with chest CT, were scanned with more advanced devices (i.e. devices with ARA). For a routine chest CT, lungs (26.10±0.42, per 100,000), kidneys (18.49±0.38, per 100,000) and the liver had the maximum LAR of cancer incidence. For a routine non-contrast abdomen-pelvic CT scan, the LAR of cancer incidence in stomach, kidneys, gall bladder, pancreas and colon were significantly lower (20-30%) in more advanced devices (with ARA vs. those without). Analysis across different vendors, protocols, age groups and genders was also performed.
CONCLUSION
The advanced CT devices (with ARA vs. those without) are associated with 20-30% lower overall and organ-specific extrapolated risk of cancer incidence attributed to CT radiation.

CLINICAL RELEVANCE/APPLICATION
The overall and organ-specific extrapolated LAR of cancer associated with CT radiation can be reduced by use of more dose-efficient scanners.

SSG04-06
Dose Estimate Considerations in SECT and DECT of the Abdomen - Perceptions and Reality
Manuel Patino MD (Presenter): Nothing to Disclose, Jorge Mario Fuentes MD: Nothing to Disclose, Yasir Andrabi MD, MPH: Nothing to Disclose, Koichi Hayano MD: Nothing to Disclose, Mukta Dilipkumar Agrawal MBBS, MD: Nothing to Disclose, Dushyant V. Sahani MD: Research Grant, General Electric Company

PURPOSE
Radiation dose remains a critical concern with the use of new CT techniques in the clinical practice. Therefore the purpose of the study is to compare Size Specific Dose Estimate (SSDE) between Single source Dual-energy (ssDECT) and Single-energy abdominal CT scans using current ACR-Dose Index Registry as reference standard.

METHOD AND MATERIALS
A total of 150 patients with cancer history (61 Males, 89 Females) underwent a follow up CE-ssDECT (GE-CT750 HD, 140/80 kV; 375-630 mA) of the abdomen-pelvis. Their recent prior CE-SECT (16-64 MDCT, 120 kV; 41-531 mA) reconstructed using FBP in 84 patients and Iterative techniques in 66, served for dose estimate comparison. Size Specific Dose Estimate (SSDE) was calculated and compared between DECT and SECT using t-test. Dose Index Registry data was used as reference.

RESULTS
The mean SSDE on ssDECT, SECT-FBP and SECT-IRT were 15.6 mGy, 14.9 mGy and 12.1 mGy respectively. There was no significant difference in SSDE between DECT and SECT-FBP (p>0.05). A difference was found in SSDE between ssDECT and SECT-IRT (p

CONCLUSION
For cancer follow-up abdomen studies, the dose estimates from ssDECT are comparable to SECT-FBP and slightly higher than SECT-IRT but remain substantially lower than ACR-DIR data.

CLINICAL RELEVANCE/APPLICATION
Dual energy CT has demonstrated added value in clinical diagnosis. However, radiation dose is still a critical concern that limits its wide implementation. This study shows comparable dose estimates between SECT and ssDECT, with minimally high SSDE in DECT, decreasing perceived radiation concerns.

SSG04-07
Effective Dose in CT Examinations: How Much Is the Effective Dose Varying between Follow-up Examinations Performed on the Same CT Scanner?
Saravanan Suntharalingam (Presenter): Nothing to Disclose, Franz Ferdinand Stecker: Nothing to Disclose, Jens Matthias Theysohn MD: Nothing to Disclose, Michael Forsting MD: Nothing to Disclose, Adrian Stefan Ringelstein MD: Nothing to Disclose, Thomas W. Schlosser MD: Nothing to Disclose, Kai Nassenstein: Nothing to Disclose

PURPOSE
To investigate, how much the effective dose (ED) varies between follow-up examinations performed on the same CT scanner.

METHOD AND MATERIALS
The effective dose (ED) was estimated retrospectively for 50 patients suffering from cancer at three different times of CT examination. At each time, a CT scan of the chest (CH), of the liver without contrast enhancing (LI) and of the entire abdomen after contrast media application (AB) was performed using the same predefined CT protocol and the same CT scanner (Siemens Definition FLASH). For automated radiation dose reduction Care Dose 4D and Care KV (Siemens) were used. Data were assessed following recommendations of ICRP 103 using Radimetrics’ dose-monitoring-software Exposure™.

RESULTS
The mean ED for CH was 5.0 ± 1.9 mSv, for LI 4.9 ± 2.0 mSv, and for AB 7.6 ± 3.3 mSv. The mean differences of ED between follow-up examinations were 0.8 ± 1.1 mSv for CH, 0.6 ± 0.7 mSv for LI, and 1.2 ± 1.6 mSv for AB. The differences between ED of follow-up examinations showed only a weak correlation to the differences in the tube current (CH: 12.5 ± 10.8 mAs, r = 0.85; LI: 10.4 ± 10.2 mAs, r = 0.78; AB 14.8 ± 18.2 mAs, r = 0.70). The differences between the ED of follow-up examinations showed only a weak correlation to the differences in scan length (CH: 22.0 ± 20.4 mm, r = 0.03; LI: 14.2 ± 12.7 mm, r = 0.11; AB 21.4 ± 20.9 mm, r = 0.35). Even though in the vast majority of CT examination the tube voltages had not been changed between follow-up examinations, changes in the tube voltage in individual cases had major effect on ED.

CONCLUSION
A high variance of the effective dose exists between follow-up CT examinations, when using the same CT...
scanner and scan protocol. This variance is predominantly caused by differences in the tube current, which had been automatically determined by the dose reduction algorithm.

CLINICAL RELEVANCE/APPLICATION

Improvements in the automated tube current modulation algorithm are necessary to reduce radiation dose in CT.

SSG04-08

Feasibility of Low-tube-current Gemstone Spectral Imaging (GSI) Associated with Adaptive Statistical Iterative Reconstruction (ASiR) in Upper Abdominal CT Angiography (CTA)

Qingguo Wang (Presenter): Nothing to Disclose, Zhiguo Zhou: Nothing to Disclose, Qimeng Quan MD, PhD: Nothing to Disclose, Zheng Wang MD: Nothing to Disclose, Han Wang MD, PhD: Nothing to Disclose

PURPOSE

To evaluate the impact of low-tube-current GSI associated with ASiR on radiation dose and image quality in upper abdominal CTA.

METHOD AND MATERIALS

Twenty-six patients who underwent GSI for upper abdominal CTA using a 64-row CT scanner (GE Discovery CT750 HD) were enrolled. Before confirming GSI scan, GSI assist software allowed optimal mA selected automatically based on the scout view and noise index at 12. Patients were retrospectively divided into two groups. Group A (n=14) and group B (n=12) underwent CT scan with high tube current (≥560mA) and low tube current (?)

RESULTS

The mean CTDIvol and effective radiation dose in group B (11.55 ±2.94mGy, 4.48 ±1.34mSv) were significantly lower than group A (18.13±3.64mGy, 7.56 ±2.68mSv) (p< 0.01). There were not significantly different mean CT values of AR and SMA (219.40±36.85, 194.76±40.44) between group B and group A (239.86±63.15, 217.56±59.28) (p> 0.05). The SD values of subcutaneous fat in group A (5.57±1.10) was lower than group B (7.37±2.03) (p< 0.05). There were not significantly different mean CNRs of AR and SMA between group B (61.66±14.71, 57.21±14.87) and group A (51.57±17.99, 48.17±16.66) (p> 0.05).

CONCLUSION

Compared with high tube current GSI, approximate 41% radiation dose reduction can be acquired by low-tube-current GSI associated with ASiR without degradation of image quality and noise in abdominal CTA.

CLINICAL RELEVANCE/APPLICATION

Low-tube-current GSI combined with ASIR has the ability to reduce radiation dose without image quality loss.

SSG04-09

A Quantitative Comparison of Noise Reduction across Five Commercial (Hybrid and Model Based) Iterative Reconstruction Techniques: An Anthropomorphic Phantom Study

Manuel Patino MD (Presenter): Nothing to Disclose, Jorge Mario Fuentes MD: Nothing to Disclose, Koichi Hayano MD: Nothing to Disclose, Avinash Ranesh Kambadakone MD, FRCR: Nothing to Disclose, Jennifer W. Uyeda MD: Nothing to Disclose, Dushyant V. Sahani MD: Research Grant, General Electric Company

PURPOSE

To compare the performance of three Hybrid Iterative Reconstruction Techniques (h-IRTs) (ASIR, iDose4, SAFIRE) with their respective strengths on image noise reduction on low-dose Computed Tomography (CT) exams using Filtered Back Projection (FBP) as standard reference. Also, to compare image noise reduction between h-IRTs and Model Based IRTs (MB-IRTs) (MBIR/Veo and IMR) on low dose exams.

METHOD AND MATERIALS

An anthropomorphic abdomen phantom was scanned at 100 - 120 kVp and different mAs (25-100) on three CT systems (GE Discovery CT750-HD, ASIR, MBIR/Veo; Philips iCT, iDose4, IMR; and Siemens Somatom, SAFIRE). Images were reconstructed using FBP and various strengths of IRTs. Nine noise measurements (ROI mean size 423 mm2) on extra-colonic fat for the strengths of IRTs were recorded and compared to FBP using ANOVA. Radiation dose in CTDIvol and DLP was also compared.

RESULTS

There was no significant difference on radiation dose and image noise on FBP between the scanners (p>0.05). Gradual image noise reduction was observed with each increment of h-IRT’s strength with maximum noise suppression around 50% (48.2-53.9%). Similar noise reduction was achieved on the scanners by applying specific h-IRT strengths. Maximum noise reduction on MB-IRTs was higher (68.3-81.1%) than that on h-IRTs (p

CONCLUSION

By using constant scan parameters, radiation dose and image noise on FBP are similar for different manufacturer CT scanners. Significant image noise reduction is achieved on low-dose CT images rendered with IRTs. The image noise on various scanners can be matched by applying specific h-IRT strengths. MB-IRTs attain substantially higher noise reduction over h-IRTs irrespective of the radiation dose.

CLINICAL RELEVANCE/APPLICATION

This study lends the opportunity to understand the impact of various IRTs and influence of their strengths on
the image noise. Since implementation of these techniques in clinical practice can be complex, this experience can assist in optimizing abdomen CT protocols with standard and modified dose scan parameters.

SSG05

ISP: Genitourinary (Imaging of Renal Stones Using Dual Energy CT)

Scientific Papers

CT GU

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 10:30 AM - 12:00 PM  Location: N228

Participants

Moderator
Raj Mohan Paspulati MD: Research grant from Philips Healthcare
Moderator
Naoki Takahashi MD: Nothing to Disclose

Sub-Events

SSG05-01

Genitourinary Keynote Speaker: Dual Energy CT in the Urinary Tract
Raj Mohan Paspulati MD (Presenter): Research grant from Philips Healthcare

SSG05-02

Knowledge-based Iterative Model Reconstruction Algorithm (IMR) for Evaluation of Urolithiasis: With Respect to Radiation Dose Reduction, Image Quality and Diagnostic Performance
Sung Bin Park MD (Presenter): Nothing to Disclose, Seong Hoon Choi: Nothing to Disclose, Jong Beum Lee: Nothing to Disclose, Hyun Jeong Park: Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the efficacy of knowledge-based iterative model reconstruction (IMR) algorithm for reducing image noise in ultra low-dose non-enhanced CT (ULDCT) and the diagnostic performance of ULDCT for urolithiasis.

METHOD AND MATERIALS

103 patients diagnosed with urinary stones (n=284) using both a standard-dose non-enhanced CT (SDCT, 120 kV and 150mAs) and an ultra low-dose non-enhanced CT (100kV and 20mAs) at two institutions were enrolled in the study. SDCT images were reconstructed with filtered back projection (FBP), and ULDCT images were reconstructed with FBP, hybrid iterative reconstruction (iDose level 5), and the IMR (body soft tissue level 3) algorithm. Interpretations of the two scans were performed prospectively with respect to radiation dose, objective image noise, and subjective image assessment (image quality, noise, diagnostic confidence). With SDCT-FBP as the reference standard, diagnostic performance and inter-observer agreement of ULDCT-IMR were assessed between two reviewers.

RESULTS

The average effective dose of SDCT and ULDCT was 8.31 mSv and 0.68 mSv, respectively, and the average radiation dose reduction rate was 91.82% (p<0.01). Objective image noise was lower in ULDCT-IMR (p<0.01) than SDCT-FBP as well as ULDCT-FBP and ULDCT-iDOSE. The subjective assessment in ULDCT-IMR was comparable to that of SDCT-FBP, although SDCT-FBP was still superior statistically. Among 284 urinary stones detected by SDCT-FBP, 229 (80.6%) were detected by ULDCT-IMR, in which detection percentage were 66/69 (95.7%) for ureter stones and 155/207 (74.9%) for kidney stones. Non-detectable stones were 3 mm or less in size, which are clinically insignificant. Inter-observer agreement of ULDCT-IMR between the two reviewers in the diagnosis of stones was high with kappa values (kappa = 0.82, excellent).

CONCLUSION

ULDCT-IMR provided a significant reduction in radiation dose while maintaining diagnostic performance and image quality comparable to that of SDCT-FBP for diagnosing urinary stones.

CLINICAL RELEVANCE/APPLICATION

Patients with urolithiasis can be evaluated with ultra low-dose non-enhanced CT using knowledge-based iterative model reconstruction algorithm at a substantially reduced radiation dose, thereby minimizing risks to patient from radiation exposure while providing the clinically relevant diagnostic benefits.
Urinary Stone Material Classification

Xinhui Duan PhD : Nothing to Disclose, Mingliang Qu MD : Nothing to Disclose, Guozhi Zhang : Nothing to Disclose, Zhoubo Li (Presenter) : Nothing to Disclose, Lifeng Yu PhD : Nothing to Disclose, Shuai Leng 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

To assess the impact of increased spectral separation on urinary stone classification in phantoms mimicking a range of patient sizes.

METHOD AND MATERIALS

87 human urinary stones of 5 common types (uric acid, cystine, calcium oxalate, brushite, calcium apatite) were scanned in 35, 40, 45, and 50 cm wide anthropomorphic phantoms. Data were acquired using 2 dual-source CT scanners. On scanner A (SOMATOM Force, Siemens), we used 150 kV and 0.6 mm tin on the high-energy tube and 70, 80, 90 or 100 kV on the low-energy tube. On scanner B (Definition Flash, Siemens), we used 140 kV and 0.5 mm tin on the high-energy tube and 80 or 100 kV on the low-energy tube. The volume CT dose index (CTDIvol) for all kV combinations matched clinical values (e.g. 13.5 mGy for 35 cm phantom). A decrease in the mean CT number of water > 10 HU was used as objective evidence of photon starvation; images meeting this criterion were removed from the analyses. Ratios of the CT numbers in the low and high energy images were calculated and used to differentiate uric acid (UA) from all types of non-UA stones, and oxalate from apatite stones. The ability to accurately classify stone type was assessed using receiver operating characteristic (ROC) analysis.

RESULTS

The 100/150 Sn kV combination on Scanner A was the only combination to avoid photon starvation artifacts across all phantom sizes; 70 kV combinations avoided artifact only for the 35 cm phantom. For scanner B, no kV combinations avoided starvation artifacts for the 45 and 50 cm phantoms; 80 kV combinations avoided artifact only for phantoms ≤ 40 cm. Spectral separation increased the area under the ROC curve (AUC) for differentiation of UA and non-UA stones for large phantoms, e.g., 0.95 (Scanner A, 100/150 kV) vs. 0.63 (Scanner B, 80/140 kV) for the 50 cm phantom. At each phantom size, the AUC for oxalate vs. apatite stones was higher for all kV combinations on Scanner A than any kV combination on Scanner B.

CONCLUSION

Increased spectral separation between the low and high energy x-ray beams resulted in decreased photon starvation artifact in large phantoms, and improved classification of urinary stones, particularly for oxalate and apatite stones.

CLINICAL RELEVANCE/APPLICATION

Increased spectral separation in dual-energy CT improves the ability to characterize renal stone types, especially for large patients.

SSG05-04

Renal Stone Composition in Vivo Determination: Comparison between 100/140 kV Dual-energy CT and 120 kV Single-energy CT

Matteo Bonatti MD (Presenter) : Nothing to Disclose, Federica Ferro : Nothing to Disclose, Patrizia Perner : Nothing to Disclose, Armin Pycha : Nothing to Disclose, Giampietro Bonatti : Nothing to Disclose

PURPOSE

To compare in vivo accuracy of 100/140 kV dual-energy CT with 120 kV single energy CT in determining renal stone composition by means of an automated software.

METHOD AND MATERIALS

Retrospective study (Jan 2013-Dec 2013) approved by our Institutional Review Board; informed consent was obtained. We included in our study 30 consecutive patients who underwent a CT on our second-generation dual-source scanner according to a "renal stone protocol", which included a 120 kV single-energy acquisition of the whole abdomen followed by a 100/140 kV dual-energy acquisition of to the region(s) where one or more stones were identified, with subsequent renal stone surgical extraction or spontaneous expulsion within 1 month and stone examination by means of infrared spectroscopy. Stone largest diameter, estimated volume, attenuation values at 100, 120 and 140 kV, and 100/140 kV attenuation ratios were calculated by means of an automated software (Syngo.via, "CT Dual Energy - Kidney Stones" application). At CT, renal stones were classified as follows: uric acid (attenuation at 120 kV > 1064HU; >1.24).

RESULTS

50 stones were detected in 30 patients. At laboratory, 17/50 (34%) of the stones were prevalently composed by uric acid, 4/50 (8%) by cystine and 29/50 (58%) of calcium oxalates and phosphates. Stones showed a median diameter of 4.8mm (range 1.0-24.1mm) and a median volume of 35.7mm3 (1.9-1390.0mm3). 120kV single-energy CT correctly assessed stone composition in 26/50 (52%) of the cases, whereas dual-energy CT in 45/50 (90%) of them.

CONCLUSION

Dual-energy CT performs significantly better then single-energy CT in renal stone composition determination and reliably discriminates between uric acid and non-uric acid stones. Ureteral catheters may reduce dual-energy CT accuracy in ureteral stones composition determination.
**CLINICAL RELEVANCE/APPLICATION**
Automated dual-energy CT renal stone evaluation reliably determines renal stone composition in vivo and, therefore, represents a useful tool for therapeutic planning.

**SSG05-05**

**Accurate Assessment of Urinary Stone Volume Using Virtual Non Contrast (VNC) Images Created from Contrast-Enhanced Dual-Energy CT (DECT) Scans**

Juan Montoya (Presenter): Nothing to Disclose, Guozhi Zhang: Nothing to Disclose, Ahmed Halaweish PhD: Employee, Siemens AG, Shuai Leng PhD: Nothing to Disclose, Cynthia H. McCollough PhD: Research Grant, Siemens AG

**PURPOSE**
Previous studies noted a decrease in stone volume in VNC images created from contrast-enhanced DECT data sets, making small stones undetectable. Improvements in spatial resolution and spectral separation may decrease this limitation. In this study on a newer dual-source CT scanner model, we evaluate the accuracy with which VNC images from contrast-enhanced DECT exams can characterize the volume of urinary stones.

**METHOD AND MATERIALS**
Seventeen Uric Acid (UA) and 27 non-UA stones of different sizes (mean volume 98 mm³, range 10-330 mm³) were placed in 1.5 ml vials, submerged in 35 and 40 cm wide water phantoms, and scanned with a newer dual-source CT scanner (Siemens Somatom Force). Images were reconstructed using a medium sharp kernel, 1.0-mm thickness and 0.8-mm interval. Initially, vials were filled with saline in order to acquire True Non-Contrast (TNC) data, which were reconstructed as mixed DECT images. The saline was then replaced with iodine solutions having concentrations consistent with clinical CT urogram studies (40 and 80 mg/ml). Scans were repeated for each iodine concentration and VNC images were created using commercially available software (Siemens, Syngo Via VA30). Using a custom Matlab-based program (Mathworks, Matlab 8.2), stones were segmented in TNC and VNC images with an adaptive threshold technique. After segmentation, stone volumes were calculated and a two-tailed t test was performed to compare TNC and VNC volume measurements (SAS, JMP 9).

**RESULTS**
Volume measurements from VNC images were not statistically different than those from TNC mixed images (P>0.05 for both phantom sizes and iodine concentrations).

**CONCLUSION**
VNC images created from contrast-enhanced DECT data sets can accurately quantify urinary stone volumes, which may reduce the need to obtain a separate TNC scan in CT urogram studies.

**CLINICAL RELEVANCE/APPLICATION**
VNC images may now have sufficient quality to allow omission of TNC scans in CT urography, or to allow detection and size assessment of urinary stones in routine contrast enhanced exams.

**SSG05-06**

**Ultra Low-dose MDCT for the Detection of Ureteric Stone Disease: Diagnostic Accuracy and Image Quality in Sub-milisievert MDCT Using 4th Generation Iterative Reconstruction for Noise Reduction**

Marc Regier (Presenter): Nothing to Disclose, Simon Veldhoen MD: Nothing to Disclose, Cyrus Behzadi: Nothing to Disclose, Frank Oliver Gerhard Henes MD: Nothing to Disclose, Chressen Catharina Remus MD: Nothing to Disclose, Azien Laqmani: Nothing to Disclose, Gerhard B. Adam MD: Nothing to Disclose

**PURPOSE**
The purpose of the presented study was to assess the diagnostic accuracy and image quality of sub-milisievert MDCT provided with the 4th generation IR technique iDose4™ for the detection of ureteric stone disease.

**METHOD AND MATERIALS**
In 46 consecutive patients suspected of ureteral stone disease raw data of unenhanced 256 slice MDCT (120kV, 20mA, mean CTDIvol: 0.9mGy; 29male, 17female; mean age, 42years) were reconstructed using iDose4™. IR level settings were varied between 0 (filtered-back-projection (FBP)), 4 and 6. Images were reconstructed with a slice thickness of 3mm. Image analysis was independently performed by two blinded radiologists who assessed location and diameter of ureteral calculi. The level of confidence was recorded based on a 3-point scale (1, inconclusive; 3, confident). For evaluation of image quality a 4-point grading scale was applied regarding the depiction of anatomical details of the upper urinary tract and degree of artifacts (1, worst; 4, excellent). The signal-to-noise ratio (SNR) was assessed. Statistical evaluation included weighted kappa and Wilcoxon analysis.

**RESULTS**
A total of 26 ureteral stones was found ranging from 1 to 8 mm (mean, 3.2 mm). Sensitivity rates were equivalent for FBP and IR, regardless of the iteration level. The level of confidence was superior for data sets reconstructed with IR (FBP, 2.4; IR4, 2.6; IR6, 2.6; p>0.05). Compared to FBP (mean score, 2.78) a significant improve in image quality was assessed applying an IR level of 4 (mean score, 3.41; p=0.02). However, applying the highest iDose4™ level of 6 blotchy appearance of anatomical contours was observed limiting image quality (mean score, 3.16). Interrater agreement was excellent (κ, 0.91; p
Urinary stone disease can reliably be achieved by ultra low-dose MDCT at radiation doses in the submillisievert range. Whereas the application of IR does not affect the accuracy of stone detection, a slight improvement in diagnostic confidence and a significant increase in image quality can be reached applying IR level 4.

**Clinical Relevance/Application**

Applying IR of the 4th generation for submillisievert MDCT of the upper urinary tract remarkably improves image quality and allows for stone detection with higher confidence compared to filtered back projection.

**Single-source Dual Energy CT (ssDECT) Renal Stone Characterization: A Multi-Parametric Approach**

Jeffry S. Kriegshauser MD (Presenter): Nothing to Disclose, Alvin C. Silva MD: Nothing to Disclose, Robert Gene Paden: Nothing to Disclose, Miao He: Nothing to Disclose, Eric Wisenbaugh MD: Nothing to Disclose, Mitchell Humphreys MD: Nothing to Disclose, Steven Ilian Zell MD: Nothing to Disclose

**Purpose**

Evaluate predictability of renal stone composition using values for 53 variables obtained with ssDECT and by applying selected data analysis algorithms.

**Method and Materials**

Thirty-two ex vivo stones found to be >90% pure by IR spectroscopy (IRS) were evaluated with ssDECT using up to 53 variables, including size, effective Z, density (in HU) at 11 monochromatic keV values, and 40 material density pairs. Data was evaluated using several algorithms, including ANN, Random Tree, and NB Tree models. A subset of 23 stones, which excluded stones less than 5 mm, also was evaluated using up to 26 variables. Seventeen stones measuring 5 mm or larger removed from 13 patients were evaluated in vivo with ssDECT using up to 11 variables, focusing on commonly available variables: density (70 keV), effective Z, and iodine and water pairs. IRS determined true composition.

**Results**

In the 32 stone dataset, 14 were uric acid (UA) and 18 non-UA stones. Non-UA stones were 7 cystine (CYS), 7 struvite (STR) and 4 calcium oxalate (CaOx) stones. In the 23 stone dataset, 12 were uric acid (UA) and 11 non-UA stones. Non-UA stones were 5 CYS, 4 STR and 2 CaOx stones. In vivo stones included 2 UA, 2 CYS, 12 calcium-based (90-100% CaOx Monohydrate (COM) mixtures of COM with CaOx Dehydrate and calcium phosphonates), and 1 N4-Acetyl-Sulfomethoxazol. Several algorithms could predict UA versus non-UA with 100% accuracy in all sets and water-iodine material density pairs were also 100% accurate. Non-UA stones were determined less accurately, with the best models 64% accurate for all 32 ex vivo stones, improving to 82% for stones >5mm (23 stone dataset). Both errors in the latter set were misclassified STR stones. In vivo, 1 small (5 mm) calcium-based ureteral stone was misclassified as CYS and the N4-Acetyl-Sulfomethoxazol stone was classified as a calcium-based stone.

**Conclusion**

Using ssDECT, UA stones can be consistently distinguished from non-UA stones, most simply using the iodine-water material density pairs. Considerable overlap in parameters is seen with non-UA stones, although CYS and calcium-based stones are more accurately predicted than STR stones.

**Single-Phase Split-bolus Dual-Energy CT-Urography in Patients with Hematuria: Diagnostic Performance and Potential Dose Reduction**

Chiao-Yun Chen (Presenter): Nothing to Disclose, Twei-Shiun Jaw MD: Nothing to Disclose, Gin Chung Liu MD: Nothing to Disclose, Lo-Yeh Lee MD: Nothing to Disclose, Jui-Sheng Hsu MD, PhD: Nothing to Disclose, Ming-Chen Paul Shih MD: Nothing to Disclose, Chun-Nung Huang: Nothing to Disclose

**Purpose**

To assess the diagnostic performance of portal venous phase split-bolus dual-energy CT(DECT) in patients with hematuria and to measure the potential radiation dose reduction using a single-phase acquisition.

**Method and Materials**

This retrospective study received protocol approval with a waiver of informed consent from our institutional review board. Study included 110 consecutive patients who underwent unenhanced single energy CT and enhanced DECT urography for hematuria. Enhanced weighted average (WA) 120kVp, iodine-overlay and virtual nonenhanced (VNE) images were reconstructed from enhanced 80 and Sn140kVp scans. Single-phase enhanced DECT urography (iodine-overlay and VNE) images were independently reviewed by two radiologists blinded to the final diagnosis. Prospective interpretations of the true nonenhanced(TNE) and enhanced WA 120kVp images(dual-phase) were also reviewed. The standard of reference included all available clinical, imaging, pathology and laboratory data for up to 12 months after DECT urography. Sensitivities, specificities and diagnostic accuracies were recorded for prospective(dual-phase) and retrospective(single-phase) interpretations. The overall imaging quality(5-point scale) of the TNE and VNE images was also evaluated. The potential dose reduction of a single-phase from dual-phase protocol was calculated. Results were tested for statistical significance.

**Results**
Final diagnoses for hematuria were renal cell carcinoma, 17(15.5%); ureter urothelial cancer, 16(14.5%); bladder cancer, 17(15.5%); renal angiomyolipoma, 14(12.7%) urolithiasis 31(28.2%); complex cyst, 5(4.5%) and no detectable cause, 10(9%). Overall accuracy for single-phase acquisition and dual-phase acquisition were 96.7% and 97.2%(p>.05). Although the overall imaging quality of the VNE was significantly inferior to the TNE images, the quality scales of the VNE were excellent or good. The mean scores were 1.7±0.5 vs 1.0±0.2(p<.05). The mean dose of the single-phase DECT acquisition was 6.7mSv comparing with 15.4mSv of the dual-phase study.

CONCLUSION

Single portal venous phase split-bolus DECT urography using iodine overlay techniques and VNE images yield high diagnostic accuracy in patients with hematuria and potentiality to reduce radiation exposure.

CLINICAL RELEVANCE/APPLICATION

In patients with hematuria, single-phase split-bolus DECT urography provides high diagnostic accuracy and potential to reduce radiation exposure.

SSG05-09

Model-based Iterative Reconstruction (MB-IR VEOTM) with Ultra Low-dose Abdominal CT versus Adaptive Statistical Iterative Reconstruction (ASIR) in the Diagnosis of Acute Renal Colic

Mikael Fontarensky MD (Presenter): Nothing to Disclose, Agaicha Alfidja : Nothing to Disclose, Renan PERIGNON MD : Nothing to Disclose, Arnaud Schoenig : Nothing to Disclose, Christophe Perrier : Nothing to Disclose, Aurelien Mulliez : Nothing to Disclose, Laurent Guy : Nothing to Disclose, Louis Bernard Boyer MD : Nothing to Disclose

PURPOSE

To evaluate the accuracy of ultra-low dose abdominal CT in the diagnosis of acute renal colic with a new generation model-based iterative reconstruction MB-IR / VeoTM, comparing it to low dose abdominal CT using 50% Adaptive Statistical Iterative Reconstruction (ASIR 50%).

METHOD AND MATERIALS

Prospective monocentric study including 118 patients with symptoms of acute renal colic who underwent 2 successive CT acquisitions: « Standard-ASIR50% » and « ultra-low dose VeoTM ». Two readers independently reviewed both CT examinations concerning the presence of renal colic, differential diagnoses and associated abnormalities. The results and doses as well as image quality of both two CT expositions were compared.

RESULTS

Intra observer correlation was 100% for the diagnosis of renal colic (kappa κ=1), τ=98.7% κ=0.97, and τ=98.16% κ=0.95 respectively for the detection of calculus and uretero hydronephrosis, and / τ=98.87% κ=0.95 for differential or alternative diagnoses. Ultra-low dose CT using VeoTM allows a reduction of 84% of the dose delivered (DLP = 92.07±44.58 versus 586±270.01 mGy.cm p<0.001), without any significant alteration of image quality (mean score 3.83±0.49/4 for ultra-low dose VeoTM versus 3.92±0.27/4 for ASIR 50 % (p=0.32), nor increase in noise (18.36±2.53 versus 17.40±3.42UH).

CONCLUSION

Ultra-low dose CT using model-based iterative reconstruction MB-IR/VeoTM allows a dose reduction (84%) without any noise increase or alteration of image quality in the diagnosis of acute renal colic. We have also determined a threshold of 40mGy.cm in abdominal CT.

CLINICAL RELEVANCE/APPLICATION

Detection of renal colic with ultra low-dose CT-scan using Model-based iterative reconstruction VEOTM is as accurate as standard CT-Scan with adaptative statistical iterative reconstruction (ASIR), and allows a dose reduction of 84%.
**SSG06-01**  
**Health Service, Policy & Research Keynote Speaker: Value in Diagnostic Imaging**  
Janie M. Lee MD (Presenter): Nothing to Disclose

**SSG06-02**  
**Have Incentives to Improve Quality of Care Led to Unnecessary CT Scanning in Major Trauma?**  

**SSG06-03**  
**Incorporating the Effects of Radiation Exposure from CT-Angiography and Perfusion in Cost-Effectiveness Analyses in Subarachnoid Hemorrhage**  
Jana Ivanidze MD, PhD (Presenter): Nothing to Disclose, Resmi Charalel MD : Nothing to Disclose, Omar Nabil Kallas : Nothing to Disclose, Matthew Simon MD, MSc : Nothing to Disclose, Ajay Gupta MD : Nothing to Disclose, Pina Christine Sanelli MD : Nothing to Disclose

**METHOD AND MATERIALS**
We modified our previous decision model comparing CTAP and transcranial Doppler ultrasound (TCD) by incorporating the long-term risk of developing brain cancer from CTAP. The clinical pathways were developed according to published guidelines. The input probabilities were based on literature data as well as a cohort at our institution. Outcome health states reflect functional SAH outcomes, combined with the delayed outcome of developing brain cancer. Cancer risk was calculated using National Cancer Institute (NCI) methodology. Radiation doses for CTAP and latency of onset of brain cancer after radiation exposure were taken from published literature. Expected health benefits and costs were calculated for each imaging strategy. Univariable and multivariable sensitivity analyses were performed.

**RESULTS**
The CTAP strategy was dominant over the TCD strategy when incorporating brain cancer risk, calculated as 0.000274 (95% CI: 0.000053; 0.000802). Our results remained robust in a two-way sensitivity analysis when varying the brain cancer risk within the CI limits and the latency of cancer onset from 0.1 to 30 years. Even assuming higher risk (up to 50 times higher than calculated), the CTAP strategy (NEW strategy) remained dominant over the TCD strategy (STANDARD strategy) for the published brain cancer latency of 10 years (Figure 1).

**CONCLUSION**
While the development of brain cancer from radiation exposure in patients undergoing CTAP is an important consideration, it does not alter the fact that CTAP is the preferred imaging strategy compared to TCD, with overall improved clinical outcomes and lower healthcare costs. This is true even when modeling a significantly higher risk and shorter latency period than what is known from published literature.

**CLINICAL RELEVANCE/APPLICATION**
While accounting for the risk of developing radiation-induced brain cancer, CTAP remains the superior imaging modality in SAH, resulting in improved clinical outcomes and lower healthcare costs.

**PURPOSE**
Establishing the value of imaging through cost-effectiveness analyses has become a major focus in our changing healthcare environment. Despite concerns regarding the effects of radiation exposure from CT, there have been no cost-effectiveness analyses incorporating these risks. The purpose of this study was to determine the benefits and harms of radiation exposure from CT angiography and perfusion (CTAP) in aneurysmal subarachnoid hemorrhage (SAH).

**RESULTS**
There was a statistically significant increase in the percentage of major trauma CTs immediately after the introduction of these payment incentives (p< 0.01) although the percentage of negative CTs (p<0.05) for the same intervals. There was also a significant increase in the percentage of whole body CTs immediately after the introduction of these payment incentives (p< 0.01) although the percentage of...
whole body CTs did not increase beyond the immediate time interval.

CONCLUSION

There was a significant increase in both the percentage of major trauma CTs in 2011 and 2012 as well as the percentage of these studies that had negative findings. The increased percentage of negative CTs is a particular area of concern as it could indicate some patients are being unnecessarily scanned.

CLINICAL RELEVANCE/APPLICATION

The 1-hour to scan target may lower the threshold for scanning patients at low risk in order to avoid possible financial loss. This could result in patients having a CT when they may have otherwise been managed without imaging. This could be a potentially unintended consequence of designing policy incentives whereby reimbursement is linked to rapid access to imaging.

SSG06-04
Different Imaging Strategies in Patients with Suspected Basilar Artery Occlusion: A Cost-effectiveness Analysis

Sebastian Ekkehard Beyer (Presenter): Nothing to Disclose, Birgit Betina Ertl-Wagner MD: Nothing to Disclose, M.G. Myriam Hunink MD, PhD: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose, Wieland H. Sommer MD: Nothing to Disclose

PURPOSE

To evaluate the cost-effectiveness of different non-invasive imaging strategies in patients with suspected basilar artery occlusion.

METHOD AND MATERIALS

A Markov decision analytic model was used to evaluate long-term outcomes resulting from strategies employing non-enhanced CT, CT angiography, or magnetic resonance (MR) angiography. The analysis was performed from the societal perspective using US recommendations for such analyses. Input parameters were derived from the literature. Costs were obtained from US costing sources and published literature. Outcomes were lifetime costs, quality-adjusted life-years (QALYs), incremental cost-effectiveness ratios, and net monetary benefits (NMB), with willingness-to-pay (WTP) thresholds of $50,000 and $80,000 per QALY. The strategy with the highest net monetary benefit was considered the most cost effective. Extensive deterministic and probabilistic sensitivity analyses were performed to explore the effect of varying parameter values.

RESULTS

In the reference case analysis, both CTA and MRI resulted in a similar increase in QALYs (0.31 and 0.33, respectively) compared to non-enhanced CT. MRI yielded 0.02 QALYs more than CTA at a cost of $44,668 per QALY gained. At WTP thresholds of $50,000 and $80,000 per QALY, MRI yielded the highest NMB. The probability that MRI is cost-effective was 51% at a WTP threshold of $50,000/QALY and 63% at $80,000/QALY (figure).

CONCLUSION

Our results suggest that MRI in patients with suspected basilar artery occlusion is cost-effective in the American setting.

CLINICAL RELEVANCE/APPLICATION

In diagnosing basilar artery occlusion, MRI should be the initial test.

SSG06-05
Contemporary Clinical Trends in Surgical Resection vs. Percutaneous Thermal Ablation Therapy for Stage I Renal Cell Carcinoma: A Surveillance, Epidemiology and End Results (SEER) Population Study

Nima Kokabi MD (Presenter): Nothing to Disclose, Minzhi Xing MD: Nothing to Disclose, Richard Duszak MD: Nothing to Disclose, Kimberly E. Applegate MD, MS: Co-editor, Springer Science+Business Media Deutschland GmbH Advisory Board, WellPoint, Inc, Juan Camilo Camacho: Nothing to Disclose, David H. Howard PhD: Nothing to Disclose, Hyun Sik Kim MD: Nothing to Disclose

PURPOSE

To investigate contemporary national practice trends in the utilization of percutaneous thermal ablation (TA) (radio frequency ablation (RFA) and cryoablation (CRA)) for treating stage I renal cell carcinoma (RCC) and identify possible sociodemographic factors that determine receipt of surgical vs. TA therapy.

METHOD AND MATERIALS

Using the most update SEER database, we identified all patients with stage T1N0M0 RCC who were diagnosed between years 2004 to 2010 and underwent either TA or surgical resection (partial nephrectomy (PN) or radical nephrectomy (RN)). Sociodemographic, geographic, and clinical determinants of trends in use of surgery vs. TA were evaluated using chi-square and logistic regression models. Sub-analysis of differences in utilization of TA between 2004-2007 vs. 2008-2010 was also performed.
RESULTS

Overall, 39,307 patients were diagnosed with T1N0M0 RCC. Of those, 37,739 (96%) underwent surgical resection (13,442 PN and 24,297 RN). Of the remaining 1568 patients who were treated with thermal ablation, 921 received CRA and 647 underwent RFA. There was no significant difference in the proportion of TA’s performed between 2004-2007 vs. 2008-2010 (3.8% vs. 4.1%, p=0.43). The proportion of cryoblation performed between 2008-2010 was significantly higher compared to the prior 3 years (23% vs. 65%, p<0.001). Patients with older age, smaller tumor size (<4cm), lower histologic grade of tumor (I and II), residing in urban settings, with higher education levels, and higher median income were more likely to receive TA according to both uni- and multivariate analyses.

CONCLUSION

Only a small proportion of organ-confined stage 1 RCC appear to be treated by TA with potential underutilization of less invasive percutaneous therapies compared to surgery. Older age, smaller tumor size, and more favorable sociodemographics status are significant determinants of receipt of TA vs. surgery.

CLINICAL RELEVANCE/APPLICATION

There appears to be significant underutilization of less invasive percutaneous thermal ablation therapies for treatment of stage 1 RCC, which are also less costly with lower associated complication rates compared to surgery.

SSG06-06

Neuroimaging Utilization and Hospitalization Cost for Patients Admitted with Stroke and Transient Ischemic Attack

Lukasz Babiarz MD, MBA (Presenter): Nothing to Disclose, Stella Liang: Nothing to Disclose, Paul Intihar MS : Nothing to Disclose, David M. Yousem MD : Royalties, Oakstone Publishing, LLC Author with royalties, Reed Elsevier Research Grant, Bayer AG

PURPOSE

We set out to assess the changes in neuroimaging utilization and its effect on hospitalization cost of patients admitted with stroke and transient ischemic attack (TIA) between 2004 and 2013 at a major urban academic medical center.

METHOD AND MATERIALS

Hospital billing and administrative data were used to identify inpatients discharged with stroke and TIA diagnoses during 2004-2013. Basic demographics, hospital length of stay (HLOS), number of neuro-CT and MR exams performed, case complexity, intensive care unit (ICU) stay, surgical intervention, and neuroimaging, ICU, surgical, and total hospitalization cost were collected. Summary statistics and compound annual growth rates (CAGRs) for cost components were calculated.

RESULTS

3,582 patients (mean age: 62.1 years; 1,818 Female) were admitted with stroke and TIA during 2004-2013. Mean HLOS was 4.62 days (annual range: 4.12-4.95 days). Mean case complexity was 1.004 (annual range: 0.928-1.132). Comparing 2004 to 2013: the proportion of patients having neuro-CTs increased from 84% to 86%; having neuro-MRs from 77% to 91%; and requiring ICU care from 15% to 24%. The average number of CTs and MRs per admission increased from 1.4 to 2.3 and from 1.1 to 2.6, respectively. As a percent of total hospitalization cost, CT grew from 2.0% to 4.7% and MR from 8.2% to 14.9%. During 2004-2013, 3.2% patients required ICU/surgical care, 13.2% ICU care, 4.7% surgical care, and 78.8% required neither. ICU care comprised ~32% of total cost. The number of neuro-scans for ICU/surgical patients grew from 3.1 to 9.1 (CAGR=12.7%), for ICU patients from 3.6 to 5.6 (CAGR=5.1%), for surgical patients from 3.3 to 4.8 (CAGR=4.5%), and for the remaining patients from 2.3 to 4.4 (CAGR=7.2%). The total and non-neuroimaging cost grew at CAGR of 4.5% and 3.0%, respectively.

CONCLUSION

Neuroimaging utilization for patients admitted for stroke and TIA has increased with a greater percentage of patients being imaged and a greater number of studies being performed per patient. Neuroimaging cost has gone up and it was responsible for 1/3 of all interval hospitalization cost increases. ICU and surgical patients undergo more neuroimaging.

CLINICAL RELEVANCE/APPLICATION

Neuroimaging utilization for patients with stroke and TIA has been increasing. This has contributed to the interval increase in hospitalization cost.

SSG06-07

The Effect of Demographics and Socio-Economic Factors on Survival in Unresectable Hepatocellular Carcinoma: a Surveillance, Epidemiology and End Results (SEER) Population Study

Minzhi Xing MD (Presenter): Nothing to Disclose, Nima Kokabi MD : Nothing to Disclose, Richard Duszak MD : Nothing to Disclose, Kimberly E. Applegate MD, MS : Co-editor, Springer Science+Business Media Deutschland GmbH Advisory Board, WellPoint, Inc, Juan Camilo Camacho : Nothing to Disclose, Hyun Sik Kim MD : Nothing to Disclose

PURPOSE
To investigate long-term survival in patients with chemorefractory, unresectable hepatocellular carcinoma (HCC) based on demographics and socio-economic factors in a large-scale population study.

METHOD AND MATERIALS

Eighteen registries of the U.S. Surveillance, Epidemiology and End Results (SEER) database were queried for patients with HCC not amenable to cancer-directed surgery/radiation diagnosed between 2000 and 2010. Mean overall survival was stratified according to patient characteristics including gender, age at diagnosis, ethnicity, geographic location, income level, education, and urbanization. Survival analysis and 95% confidence intervals (CI) were calculated using Kaplan-Meier estimation and compared using the log-rank test. Multivariate Cox proportional hazard models were used to assess independent prognostic factors for overall survival.

RESULTS

Of 63,434 newly diagnosed primary liver cancer patients in the US between 2000 and 2010, 52,944 patients had HCC. The median age of all HCC patients was 63 years, 74% (39,201) male. Overall survival was significantly correlated with age at diagnosis (<70 vs. ≥70 years, 8.9 vs. 6.9 months), ethnicity (white, black, American Indian, Asian/Pacific Islander; 7.9, 7.1, 8.3, 10.5 months, respectively), geographic location (East, Northern Plains, Southwest, Pacific Coast, Alaska; 7.6, 6.4, 7.1, 8.6, 7.6 months, respectively), income level (median household income ≥$45k vs. <$45k/year, 6.8 vs. 8.5 months), education (% with bachelor degree or above, ≥15% vs. <15%, 6.6 vs. 8.4 months), and degree of urbanization (county population ≥50,000 vs. <50,000, 8.4 vs. 6.6 months), p<0.001 for all.

CONCLUSION

Socio-demographic factors including age <70 years, Asian/Pacific Islanders, those from the Pacific coast, urban settings, higher income and education level were significantly correlated with prolonged survival in a large-scale population-based study.

CLINICAL RELEVANCE/APPLICATION

The differences in survival in patients with HCC not amenable to cancer-directed surgery/radiation may be due to disparity in access to effective palliative therapy based on patient demographics and socio-economic factors.

Bundled Inpatient Radiologist Imaging Professional Services: An Empiric Episode Frequency Focused Approach to Bundled Payment Modeling

Richard Duszak MD (Presenter): Nothing to Disclose, Nadia Bilal: Nothing to Disclose, Danny Hughes PhD: Nothing to Disclose, David Andrew Rosman MD: Nothing to Disclose

PURPOSE

As healthcare payment systems evolve from fee-for-service to value-based episodic bundles, much interest has focused on inpatient payments to hospitals, particularly as they relate to length of stay and readmissions. Physician services, including those of radiologists, have been largely ignored. In anticipation of inpatient bundled physician professional payments, we aimed to develop an evidence-based episode frequency focused strategic framework for identifying encounters where initial bundled payment modeling might be most impactful.

METHOD AND MATERIALS

Using a 5% random sample of all approximately 32 million Medicare beneficiaries from 2011, we first used Part A (hospital) claims data to categorize all inpatient admissions using Medicare Severity Diagnosis Related Groups (DRGs). Imaging professional services (defined by Berenson-Eggers Types of Service) rendered by radiologists associated with each episode were then identified separately using Part B (physician services) claims data. Inpatient admission DRGs involving radiologist professional services were frequency ranked by to identify those disproportionately associated with total inpatient encounters.

RESULTS

Of 618,906 identified inpatient admission episodes, imaging professional services were rendered in 430,707 (69.6%), attributable to nearly all (739/742; 99.6%) 742 uniquely identifiable DRGs. Just 4 DRGs, however, accounted for 11.3% of all hospital encounters involving radiologist imaging professional services (470, 871, 292, 194). The top 9 accounted for 20.1%, top 17 for 30.3%, and top 41 for 50.3%. All other 701 combined accounted for 48.5% (1.2% were non-categorizable). The bottom 506 (68.2%) DRG codes together accounted for only 10% of episodes where radiologists rendered imaging professional services.

CONCLUSION

Efforts to model radiologist inpatient professional services have been hampered by the nearly ubiquitous involvement of imaging in the inpatient setting. A very small number of DRGs, however, account for a disproportionately large share of all admissions involving imaging. These would ideally serve as the basis for initial inpatient imaging bundled payment initiatives.

CLINICAL RELEVANCE/APPLICATION

In the inpatient setting, just 4 DRGs account for 10% of all admissions where radiologists typically render services. Initial bundled payment initiatives should be evidence-based and targeted.
Classification of Renal Masses Using CT Texture Analysis: Generation of A Predictive Model on the Basis of Quantitative Spatial Frequency Measurements and Random Forest Modeling


PURPOSE

CT texture analysis (CTTA) allows the quantification of lesion heterogeneity based on the distribution of pixel intensities within a region of interest. This study investigates the ability of CTTA to distinguish between several different common renal masses, and seeks to develop a ‘random forest’ predictive model allowing the differentiation of these lesion types.

METHOD AND MATERIALS

Following IRB approval, CTTA software (TexRAD Ltd.) was used to retrospectively analyze 20 clear cell renal cell carcinomas, 20 papillary RCCs, 20 oncocytomas, and 20 Bosniak I renal cysts. Regions of interest were drawn around each mass on multiple slices, and each lesion was analyzed using arterial, venous, and delayed phase images on renal mass protocol CT scans performed with uniform technique. Analysis was performed on both unfiltered images and spatial band-pass filtered images to quantitatively assess heterogeneity. Random forest method was used to construct a predictive model to classify lesions, and separate models were constructed using either one phase in isolation or all three contrast phases in conjunction. The model was then externally validated on a separate set of 19 cases that were not used in the generation of the original random forest model.

RESULTS

The random forest model was able to successfully distinguish the four lesion types, and when utilizing all 3 contrast phases in conjunction, the model correctly categorized oncocytomas in 89% of cases (sensitivity 89%, specificity 99%), clear cell RCCs in 91% of cases (sensitivity 91%, specificity 97%), cysts in 100% of cases (sensitivity 100%, specificity 100%), and papillary RCCs in 100% of cases (sensitivity 100%, specificity 98%). Models utilizing a single contrast phase (arterial, venous, or delayed) in isolation were less accurate, with the model based only on the arterial phase images performing the best. When tested on a separate/validation set of 19 cases, the model was correctly able to categorize all 19 cases.

CONCLUSION

CTTA, in conjunction with random forest modeling, demonstrates great promise as a tool for correctly characterizing lesion types, and was able to classify four common types of renal masses with a high degree of accuracy.

CLINICAL RELEVANCE/APPLICATION

CT texture analysis allowed accurate characterization of a small subset of common renal masses, suggesting its promise as a quantitative imaging tool that may augment our ability to predict lesion histology.
PURPOSE

To reproduce accurate patient-specific coronary tree phantoms from clinical CTA and use them for in vitro CTA experiments to elucidate the intraluminal kinetics of iodinated contrast agent giving rise to the Transluminal Attenuation Gradient (TAG).

METHOD AND MATERIALS

A "four-dimensional" segmentation algorithm was developed taking advantage of cardiac motion in the CTA cardiac phase window. The algorithm iteratively combines commercial segmentations (Vitrea 6.2) of the coronary tree in individual phases to a single segmentation. This is accomplished by iteratively solving for motion between cardiac phases using least squares optimization and refining the "corresponding point" problem at each iteration. The corresponding points of individual segmentations are then combined into a single segmentation of the lumen plus its motion in-between cardiac phases. The algorithm was applied to 3 phases (70, 75, 80% of R-R) of a coronary CTA and the resulting endoluminal surface, extended with Luer connectors, was directly output in STL file format and printed on a Viper 2SI stereolithography machine (courtesy, Gerald T. Grant and Shayne Kondor, 3D Medical Applications Center, Walter Reed National Military Medical Center). The printed phantom was attached to a dual injector (Bracco Diagnostics) with one syringe loaded with saline and the other a mixture of 10:90% contrast:saline and scanned at 0.5sec intervals using a volume CTA protocol on 320-detector row CT (Toshiba) from a starting state of saline and during an injection protocol of 10s@0.1ml/s of mixture, followed by 6s@0.5ml/s of mixture, and finally 6s@1ml/s saline.

RESULTS

CTA of the printed phantom during contrast passage resulted in contrast opacification curves along the length of the coronary (Figure) of similar TAG magnitude as seen in vivo, between -26 HU/cm (upslope) to 9.5 HU/cm (downslope). Turbulence in the fluid jet due to an incidental luminal stenosis was readily detected and quantified by the CT Hounsfield units during contrast arrival.

CONCLUSION

The effect of blood flow on CTA contrast enhancement is sufficiently large to be detected by current CT technology and gives rise to the TAG observed in vivo.

CLINICAL RELEVANCE/APPLICATION

High-fidelity 3D-printed coronary artery phantoms reproduced from clinical CTA will enable understanding the principles underlying TAG measurements and how they may be properly used to detect functionally significant coronary artery disease.
Semi-Automated Quantification of Donor Kidney Volume Applied to a Predictive Model for Outcomes in Renal Transplantation

Jessica Ashley Rotman MD (Presenter): Nothing to Disclose, Paul Masi: Nothing to Disclose, Robert Spandorfer: Nothing to Disclose, Carl Cerato: Nothing to Disclose, Ashley Giambrone PhD: Nothing to Disclose, David Serur MD: Nothing to Disclose, Choli Hartono MD: Nothing to Disclose, Krishna Juluru MD: Nothing to Disclose

PURPOSE

Graft mass has been shown to be positively correlated with outcomes in kidney transplants. We investigate the use of semi-automated, CT-based quantification of graft volume as a non-invasive, pre-operative predictor of 12 and 24 month graft function.

METHOD AND MATERIALS

In this retrospective study, all transplants over a 3 year period in which donors obtained CT scans for routine pre-operative evaluation were included, and transplants in which recipient outcomes data were unavailable were subsequently excluded. Using a commercially-available reconstruction tool, donated kidney cortical and whole parenchymal volumes (DKV) were measured independently by two observers. Transplant characteristics recorded by chart review included donor/recipient demographics, recipient weight (RW), transplant immunological matching, history of acute rejection, delayed graft function, and/or viral infections, and recipient creatinine values at multiple time points. Intra-class correlation (ICC) of measurements by the two observers was calculated. DKV/RW ratios were correlated with graft function over 24 months and utilized in logistic regression models to calculate odds of developing diminished renal function.

RESULTS

150 transplants met inclusion/exclusion criteria. Cortical and total parenchymal measurements demonstrated high reproducibility between the two observers (ICC = 0.93-0.94). Unadjusted correlations existed between eGFR and DKV/RW ratio at 12 (R=0.82) and 24 months (R=0.78). After adjusting for transplantation parameters, recipients in the highest DKV/RW ratio tertile had persistently higher mean eGFR at all timepoints over 24 months than recipients in lower tertiles. Recipients in the highest tertile had a significantly reduced risk of developing diminished renal function as compared to recipients in the lowest tertiles at 12 and 24 months post transplant (adjusted OR = 0.15 and 0.10, respectively).

CONCLUSION

DKV/RW ratio is a non-invasive, readily-obtained, reproducible parameter that is a predictor of 12 and 24 month renal transplant outcomes.

CLINICAL RELEVANCE/APPLICATION

Transplant outcomes can be improved by incorporating DKV/RW ratio into the renal donor/recipient selection process.

CT Texture Analysis of Histologically Proven Benign and Malignant Lung Lesions


PURPOSE

To assess differences in CT texture of histologically proven benign and primary malignant lung lesions.

METHOD AND MATERIALS

Our ongoing IRB approved study included 62 patients (28M; 34F; mean age 64 years; range27-88) who underwent CT guided biopsy and had definitive diagnosis on pathology [22 benign (9 tumor and tumor-like and 13 acute infections), 40 malignant (17 well differentiated and 23 poorly differentiated primary lung adenocarcinomas)], over a period of three years. All mediastinal, chest wall, pleural lesions and pulmonary metastases were excluded. CT texture analysis of all biopsied lesions was performed on the pre-biopsy non-contrast CT images using a commercially available software (TexRAD limited, UK). For each patient, regions of interest were drawn on a single image with largest lesion dimensions. Areas of cavitation containing air were excluded. The features analyzed included mean HU values, percent positive pixels (PPP), mean value of positive pixels (MPP), standard deviation (SD), normalized SD, skewness, kurtosis, and entropy. Data were analyzed using two tailed unpaired non parametric T-test with Welch correction.

RESULTS

There were significant differences between CT texture of well- and poorly-differentiated primary lung cancers (p

CONCLUSION

CT texture analysis can separate well differentiated and poorly differentiated primary lung adenocarcinomas. There is a significant difference in SD between tumor/tumor-like lesions and infections among the benign lesions.

CLINICAL RELEVANCE/APPLICATION

CT texture analysis can help characterize malignant and benign lung lesions and can separate well differentiated primary lung cancers from poorly differentiated primary lung cancers.
Accuracy and Reproducibility of Automated, Standardized Transluminal Attenuation Gradient (TAG) Measurements in Coronary Computed Tomography Angiography (CCTA)


PURPOSE

TAG from 320-detector row CTA offers incremental value for the prediction of functionally significant coronary artery disease (CAD). However, TAG measurements are labor-intensive. We thoroughly assessed TAG accuracy and reproducibility using new automated software compared to a manual method previously validated against invasive fractional flow reserve (FFR).

METHOD AND MATERIALS

540 TAG measurements were performed in 20 patients that underwent clinically indicated CCTA on a 320-row detector CT (Toshiba AquilionONE). Two readers measured TAG manually by placing 1mm2 luminal ROIs in cross-sections orthogonal to the vessel centerline every 5 mm; two independent readers used an automated software (Cardiac Analysis Package, Toshiba). Accuracy of automated vs manual TAG and inter- and intra-observer reproducibility of both methods were assessed via linear regression and Bland-Altman analyses. Subanalyses were performed with respect to factors that can affect accuracy or reproducibility, namely a) presence/severity of CAD by CCTA or invasive angiography and SPECT (n=14 patients), b) plaque composition (calcified vs noncalcified), c) CT reconstruction method (iterative vs FBP), and d) physiologic parameters (BMI, left vs right coronaries).

RESULTS

Correlation of automated and manual measurement was excellent (y=1.0x+2.0, r=0.92, p<0.001), with low mean difference (1 HU/cm) and narrower inter- and intra-observer limits of agreement for automated vs manual (25% and 36% average reduction, respectively, Figure). The median TAG in vessels with angiography/SPECT-confirmed obstructive CAD was -23.8 (IQR: -26.6, -19.3), similar to that previously reported for vessels with FFR ≤0.8 (median -21, IQR: -27, -16). Presence and severity of CAD, plaque composition, reconstruction method, and physiologic parameters did not significantly affect accuracy or reproducibility. Analysis time was reduced by 68% per patient (13.9±3.3 min automated vs 39.8±8.7 min manual TAG).

CONCLUSION

Automated assessment of TAG is fast, accurate, and enhances reproducibility.

CLINICAL RELEVANCE/APPLICATION

Automated TAG measurement alleviates labor-intensive calculations and can thus enable studies over larger populations to establish its clinical significance for detecting hemodynamically significant CAD.
Discussion

All 24 exams, with a total of 243 liver lesions (range: 4-29 lesions), were considered of diagnostic quality and included in the study. Avg lesion size was 9.5mm, and 70% of lesions were less than 10mm. On standard HBP, 3 readers missed an average of 1.24 lesions per exam, with an overall detection rate of 88%. On MinIPs, the 3 readers missed an average of 0.79 lesions per exam with an overall detection rate of 92%. Average read time was 2:45 min for HBP and 2:37 min for MinIPs.

A Novel Technique for Organ Segmentation Utilizing Dynamic Contrast Enhanced Multiphase Datasets

Elizabeth Weidman MD (Presenter): Nothing to Disclose, Sadaf Jalili MS, RRA: Nothing to Disclose, Pascal Spincemaille PhD: Nothing to Disclose, Krishna Juluru MD: Nothing to Disclose, Jonathan Paul Dyke PhD: Nothing to Disclose

PURPOSE

Tissue enhancement curves may offer a unique organ-signature. We test the accuracy of an automated algorithm that utilizes contrast enhancement curves from dynamic MRI datasets for the purpose of liver segmentation and volume determination.

METHOD AND MATERIALS

Abdominal DCE MRIs obtained from a previously-concluded IRB approved study were retrospectively included. Scans were obtained following injection of Gd-EOB-DTPA at 0.025 mmol/kg at a rate of 1cc/s followed by saline flush. Utilizing a spiral 3D technique, images of the entire abdomen were obtained in 15 phases within the first 90 seconds, following by a single phase every minute up to 20 minutes. All phases were registered using a commercially-available software tool. The custom tool being assessed in this study (created in IDL) allowed a user to identify an organ of interest by placement of an ROI. All voxels in the entire multi-phase MRI dataset demonstrating high correlation (Pearson’s R2) with the time-intensity curve of the voxels in the ROI were determined to belong to the same organ and therefore included in segmentation. Volumes of the liver calculated by this automated technique were compared to volumes generated by manual tracing performed by an experienced 3D technologist.

RESULTS

23 DCE MRI exams were included in the analysis. Average liver volumes obtained manually and by the automated technique were 2053 ± 454 mL and 1703 ± 405 mL, respectively (p<0.0001), and were highly correlated (R2 = 0.76). Areas of discrepancy between automated technique and manual segmentation were most frequent at the periphery of the liver due to signal intensity loss secondary to respiratory motion and receiver coil placement.

CONCLUSION

Liver volumes obtained by the automated and manual techniques were highly correlated. Unlike manual measurements, automated measurements excluded intra-hepatic vascular structures, likely explaining the systematic reduction in automated volumes as compared to manual, and in fact likely providing a more accurate estimate of liver parenchymal volume. Tissue time-intensity curves do offer a unique organ-signature that may be utilized for liver and other organ segmentation.

CLINICAL RELEVANCE/APPLICATION

Information in DCE MRI datasets can be utilized for automated organ segmentation and may provide an accurate, reproducible and fast method for obtaining organ volumes in surgical planning, transplant evaluation, and monitoring drug treatment response.

Semi-automated 3D Segmentation of Livers Using User-defined Landmarks in CT Images

Wenli Cai PhD (Presenter): Nothing to Disclose, Difei Lu: Nothing to Disclose, Yin Wu: Nothing to Disclose, Gordon J. Harris PhD: Medical Advisory Board, Fovia, Inc

PURPOSE

Segmentation of diseased liver remains a challenging task in clinical applications due to the high inter-patient variability of liver shapes, sizes and pathologies caused by cancers or other liver diseases. The purpose of this study was to develop a semi-automated scheme for segmentation of diseased livers with cancers using as little as five user-identified landmarks.

METHOD AND MATERIALS

Based on the 3D iterative mesh transformation constrained by 2D optimal contour searching on transversal image planes, we developed a semi-automated scheme for multi-resolution segmentation of diseased livers with cancers on CT image, called iterative mesh transformation. The initial liver mesh is defined using five liver anatomical landmarks identified by users and a set of points from the chest wall detected automatically. Liver mesh is then deformed in a progressive manner by iterations between 3D mesh transformation based on the deformation transfer model and 2D contour optimization using the dynamic-programming algorithm. Forty (40) IV-contrast enhanced hepatic MDCT cases with biopsy-confirmed liver cancers or metastases were used for evaluation of our proposed semi-automated liver segmentation scheme. The MDCT imaging parameters settings were: 2.5-5 mm collimation, 1.25-2.5 mm reconstruction interval, 175 mA tube current, and 120 kVp tube.
voltage.

RESULTS

In reference to the liver segmentation by manual-contouring of two radiologists, the volumetric size of these 40 cancerous livers ranged from 1079.2 CC to 4652.3 CC, in which the tumor volume percentages ranged from 1.77% to 53.54%. We quantify the accuracy of the proposed liver segmentation scheme by using five metrics: (1) VOE: volumetric overlap error (%), (2) RVD: relative absolute volume difference (%), (3) ASD: average symmetric surface distance (unit: mm), (4) SSD: root-mean-square of symmetric surface distance (unit: mm), and (5) MSD: maximum symmetric surface distance (unit: mm). The performance of the proposed scheme was VOE=5.88, RVD=2.57%, ASD=0.51 mm, SSD=1.05 mm, and MSD=7.12 mm.

CONCLUSION

Our semi-automated liver segmentation scheme can achieve accurate and reliable segmentation results with significant reduction of interaction time and efforts when dealing with the diseased liver cases.

CLINICAL RELEVANCE/APPLICATION

Our semi-automated 3D liver segmentation scheme can provide an accurate and efficient liver volumetric measurement for diseased livers.

SSG08

Molecular Imaging (Inflammation/Arthritis)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 10:30 AM - 12:00 PM  Location: SS04CD

Participants

Moderator
Heike E. Daldrup-Link MD : Nothing to Disclose
Moderator
Michael Stanley Gee MD, PhD : Nothing to Disclose

Sub-Events

SSG08-01

Molecular Imaging of Inflammation in Inflammatory Bowel Disease with Ultrasound: Reproducibility and Dose Escalation Study in Swine

Huaijun Wang MD, PhD (Presenter): Nothing to Disclose, Stephen A. Felt DVM, MPH : Nothing to Disclose, Isumayil Guracar : Employee, Siemens AG, Steven B. Machtaler PhD : Nothing to Disclose, Thierry Bettinger : Employee, Bracco Group, Juergen Karl Willmann MD : Research Consultant, Bracco Group Research Grant, Siemens AG Research Grant, Bracco Group

PURPOSE

To assess reproducibility and optimal dosing for ultrasound molecular imaging (USMI) of inflammation using a clinically translatable dual P- and E-selectin-targeted contrast agent (MBSelectin) in a porcine model of acute terminal ileitis.

METHOD AND MATERIALS

An acute terminal ileitis model was established in 17 pigs (ileitis pig). Another 3 pigs without inflammation served as controls. USMI was performed with a clinical system (Acuson Sequoia 512, Siemens; transducer 15L8W). Increasing doses of MBSelectin (0.5, 1, 2.5, 5, 10, and 20×10⁸ MB/kg) were injected and a total of 18 different segments of ileitis were imaged in an intra-animal comparison study. To test the reproducibility of USMI, scans of the same anatomical locations were repeated twice following both MBSelectin and non-targeted control microbubble (MBControl) administrations. After imaging, scanned ileal segments were analyzed ex vivo for both inflammation grade on HandE staining and for expression of selectins on immunofluorescence staining.

RESULTS

Signal intensities increased with higher doses of MBSelectin. However, further increase of the contrast agent dose beyond 5×10⁸ MB/kg resulted in a relatively lower further signal increase compared to lower doses (P=0.01), suggesting that the signal reached a plateau at a dose of approximately 5×10⁸ MB/kg. Using a dose of 5×10⁸ MB/kg, USMI was highly reproducible with an intraclass coefficient of 0.88 (95%CI, 0.25-0.99) using MBSelectin and of 0.84 (95%CI, 0.24-0.98) using MBControl. Administration of MBSelectin in ileitis resulted in a significantly higher (P<0.001) imaging signal compared to control ileum. Also, imaging signal using MBSelectin was significantly higher (P<0.001) compared to MBControl in ileitis. In control ileum, imaging signal was not significantly different (P=0.06) with MBSelectin or MBControl. Ex vivo analysis showed significantly higher inflammation scores and expression of selectins in acute ileitis compared to control ileum (P<0.05, Fig 1).
CONCLUSION
Quantitative measurements of inflammation obtained by selectin-targeted USMI are highly reproducible in a porcine ileitis model and correlate well with the extent of inflammation on histology.

CLINICAL RELEVANCE/APPLICATION
USMI of inflammation is reproducible and quantitative and can be further developed for monitoring patients with inflammatory bowel disease.

Magnetic Resonance gagCEST Imaging of the Human Lumbar Intervertebral Disc: Age Dependency of Glycosaminoglycan Content
Christoph Schleich (Presenter): Nothing to Disclose, Anja Lutz: Nothing to Disclose, Benjamin Schmitt: Nothing to Disclose, Hans-Joerg Wittsack PhD: Nothing to Disclose, Gerald Antoch MD: Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Falk Roland Miese MD: Nothing to Disclose

PURPOSE
The objective of this study was to investigate the age dependency of glycosaminoglycan (GAG) content in the human intervertebral disc (IVD) using biochemical MRI with glycosaminoglycan chemical exchange saturation transfer (gagCEST).

METHOD AND MATERIALS
25 healthy volunteers (mean age 46, range: 24 - 69 years, 17 females, and 8 males) were examined with a prototype gagCEST imaging sequence at a 3T MR scanner (Magnetom Trio; Siemens Healthcare). The CEST presaturation module consisted of a series of 6 Gaussian-shaped RF pulses with B1 amplitude of 1.5 µT averaged over time (B1-CWAE). The duration of each saturation pulse and interpulse delay was 100 msec. In order to increase SNR, 6 signal averages were used. After motion correction with the prototype software fMRILung (Siemens Healthcare), CEST evaluation was performed in the lumbar IVDs L2/3 - L5/S1 using the magnetization transfer asymmetry (MTRasym = MSat/M0(-Δω) - MSat/M0(Δω)) value as a method to assess gagCEST effects (figure 1). Region of interest based analysis was performed for the nucleus pulposus (NP) and the annulus fibrosus (AF). The volunteers were categorized in five age classes: 20-29 years, 30-39 years, 40-49 years, 50-59 years and 60-69 years (figure 1). Each group consisted of five volunteers. Only IVDs with Pfirrmann grade 2 were included.

RESULTS
We found significantly lower gagCEST values in NP and AF with increasing age. NP showed higher gagCEST values compared to AF (figure 1). There was a significant correlation between age and GAG content of nucleus pulposus (r = -0.592; p = 0.01). There was a significant correlation between age and gag content of annulus fibrosus (r = -0.582; p = 0.01; figure 2).

CONCLUSION
Our study suggests age dependency of intervertebral disc composition. gagCEST imaging is sensitive to age dependent cartilage visualization, despite morphologically healthy intervertebral discs (Pfirrmann grade 2).

CLINICAL RELEVANCE/APPLICATION
Biochemical imaging with gagCEST of cartilage composition is feasible in IVDs. Our study suggests age dependency of intervertebral disc composition. Lumbar IVD degeneration is a condition with high incidence and clinical as well as economical relevance. gagCEST at 3T is a new and promising tool for the research of this disease.

Diagnosis of Stem Cell Apoptosis in Arthritic Joints with MRI
Hossein Nejadnik MD, PhD (Presenter): Nothing to Disclose, Deju Ye PhD: Nothing to Disclose, Olga Il'enkov BSC: Nothing to Disclose, Jessica Donig BA: Nothing to Disclose, Jianghong Rao PhD: Nothing to Disclose, Heike E. Daldrup-Link MD: Nothing to Disclose

PURPOSE
Limited survival of transplanted stem cells represents a significant bottleneck for successful cartilage regeneration outcomes. The goal of this study was to develop a non-invasive MR imaging test for detection of stem cell apoptosis, using a caspase-3-activatable small molecular Gd-chelate (C-SNAM).

METHOD AND MATERIALS
The C-SNAM probe underwent extensive nanocharacterization by relaxivity measurements, high performance liquid chromatography (HPLC), dynamic light scattering (DLS), and transmission electron microscopy (TEM). Viable and apoptotic (Mitomycin C treated) rat adipose derived stem cells (rASCs) were incubated with C-SNAM or a non-activatable control Gd-chelate and underwent in vitro MR imaging. Then, athymic rats, with implanted viable or apoptotic Fluc-transduced rASCs in osteochondral defects, underwent MR and optical imaging before and after intra-articular injection of C-SNAM. T1-relaxation times of different groups were compared with a Student's t-test, using a p < 0.05.
RESULTS
The r1 relaxivity of the C-SNAM probe increased from 10.2 ± 1.5 mM-1s-1 to 19.0 ± 0.5 mM-1s-1, after activation by caspase-3 (p < 0.05). HPLC analysis showed a fast cyclization of the probe (half-life t1/2 < 1h) to form cyclized products. The formation of GdNPs after caspase-3 activation confirmed by DLS and TEM. In vitro, apoptotic rASCs demonstrated significant, ~50% shortening of T1-relaxation times after incubation with C-SNAM compared to viable rASCs, while T1-times after exposure with the control probe were not significantly different. In vivo, apoptotic MASI showed significantly lower T1-relaxation times compared with viable MASI at 30 minutes after C-SNAM intra-articular injection. Bioluminescent imaging confirmed cellular apoptosis of C-SNAM enhancing rASC implants.

CONCLUSION
We present a novel approach for non-invasive, high-resolution in vivo detection of stem cell apoptosis with a novel caspase-sensitive contrast agent for MR imaging. This new imaging biomarker could be applied to a wide variety of stem cell therapies, facilitate optimizations of MASI strategies, and ultimately improve successful tissue regeneration outcomes.

CLINICAL RELEVANCE/APPLICATION
The described novel MR contrast agent, a strong candidate for clinical translation, could improve MR evaluations of stem cell transplants and direct patients with failed MASI to repeated interventions.

SSG08-04
Fluorescence Molecular Imaging of Myeloperoxidase in Irritant Contact Dermatitis and Bacterial Cellulitis
Benjamin Pulli MD (Presenter): Nothing to Disclose, Cuihua Wang PhD: Nothing to Disclose, Gregory R. Wojtkiewicz MSc: Nothing to Disclose, Anning Li MD: Nothing to Disclose, Yue Wu: Nothing to Disclose, John Chen MD, PhD: Research Grant, Pfizer Inc

PURPOSE
Myeloperoxidase (MPO) is an important oxidative enzyme stored in neutrophil granules. It is crucial for defense against pathogens but also contributes to tissue damage in inflammation. We sought to develop a molecular imaging probe sensitive and specific for MPO that is suitable for fluorescence imaging applications.

METHOD AND MATERIALS
Ten female C57BL/6J (wildtype) mice and 3 MPO-knockout mice were either treated topically with 0.08 μmoles phorbol 12-myristate 13-acetate (PMA) on one hindpaw and with vehicle on the other to induce irritant contact dermatitis, or injected subcutaneously with 10^8 colony forming units of streptococcus pneumonia (SPn) to induce bacterial cellulitis. 6 hours after induction, mice were injected with the MPO sensor or a non-specific control sensor. Extracellular DNA in cellulitis was visualized with Sytox Green. Mice were imaged using a fluorescence reflectance imaging system (Olympus OV-110).

RESULTS
Sensitivity to MPO was tested first in vitro by embedding the MPO sensor together with and without MPO in matrigel. A linear increase in signal is seen only in the presence of MPO (figure, A). In vivo, increased fluorescent signal was detected with dermatitis on the hindpaws of wildtype mice injected with MPO sensor (330.5±48.2 for PMA vs. 34.8±14.9 relative fluorescent units (RFUs) for vehicle, P<0.01, figure, B+C). In MPO-knockout mice injected with MPO sensor, and in wildtype mice injected with control sensor, no signal increase was detectable (36.9±13.8 and 50.1±10.0 for PMA vs. 43.9±15.2 and 28.4±9.4 RFUs for vehicle, P>0.05, figure, B+C). In wildtype mice induced with bacterial cellulitis, increased MPO specific signal was found in the hindlimb (212.5±22.9 for SPn vs. 49.4±15.5 RFUs for vehicle, P<0.001, figure, D). Sytox green signal revealed extracellular DNA in the inflamed area consistent with neutrophil extracellular trap formation, and MPO and DNA co-localized (figure, D).

CONCLUSION
The results of this proof-of-concept study reveal that our novel fluorescent MPO sensor can specifically detect MPO activity in vivo at relevant biological concentrations. This was validated in two murine disease models. Neutrophil extracellular trap formation can be imaged by co-injection of MPO-sensor and Sytox Green.

CLINICAL RELEVANCE/APPLICATION
Upon translation, MPO fluorescence molecular imaging could be used in perioperative as well as endoscopic settings (e.g., assessment of activity of inflammatory bowel disease).

SSG08-05
Role of F-18 FDG PET/CT in Differentiating Findings of Sarcoidosis versus Malignancy
Sikandar Mohd Shaikh DMRD (Presenter): Nothing to Disclose

PURPOSE
To review F-18 FDG PET/CT findings of Sarcoidosis mimicking malignancy

METHOD AND MATERIALS
F-18 FDG PET/CT scans in which Sarcoidosis was misinterpreted as malignancy were included. Sarcoidosis was confirmed by biopsy or surgery. F-18 FDG PET/CT finding was retrospectively evaluated. The maximum standardized uptake value (SUVmax) of the primary tumors and TB mimicking malignancy were measured.
RESULTS

50 cancer patients (11 for initial staging and 14 for restaging) and 14 Sarcoidosis patients without any malignancy were included (M:F=17:13, age 45±13). Sarcoidosis involved lung (n=17), cervical (n=10), mediastinal (n=5) and abdominal (n=5) nodes, bowel (n=1), adrenal gland (n=1) and pleura (n=1) in the 32 patients. Sarcoidosis caused false positive reading in 9 cases out of 11 staging cases leading to overstaging, 12 out of 14 restaging cases, and 7 patients without any malignancy, 4 falsely considered to have lung cancer and 3 abdominal malignancy. TB involved contralateral supraclavicular node (SCN) in 5 of 7 patients with breast cancer and right SCN in 4 of 7 patients with abdominal malignancy. In staging PET/CT, the mean SUVmax of the primary tumor was 5.0±3.6 (2~11.4), while that of Sarcoidosis considered as metastasis was 4.5±2.4 (2.0~6.5) in lung and 5.6±3.3 (2.4~8.9) in lymph node. In restaging PET/CT, the SUVmax of TB considered as recurrence was 2.8±0.8 (2.2~4.3) in lung and 4.8±2.3 (2.2~8.0) in lymph node. The mean SUVmax of Sarcoidosis mimicking malignancy was 3.7±1.3 (range 2.2~4.7) in lung and 6.1±3.3 (3.4~9.7) in abdomen.

CONCLUSION

Sarcoidosis mimicked primary cancer, metastasis or recurrence on FGD PET/CT, and led to upstaging in majority of cancer patients. SUV was not useful in discrimination. When FDG uptake is seen in contralateral SCN in breast cancer patients, and right SCN in abdominal malignancy patients, Sarcoidosis should be considered as differential diagnosis.

CLINICAL RELEVANCE/APPLICATION

PET-CT HAS MANY MIMICKS IN RELATION TO NEOPLASTIC LESIONS WHICH ARE SOMETIMES VERY DIFFICULT TO DIFFERENTIATE.
Purpose: Uveitis is responsible for 10-20% of the cases of blindness in the U.S. and its economic impact is at least as great as diabetic retinopathy. The purpose of this research is to develop a targeted agent for molecular imaging of uveitis with ultrasound and fluorescence imaging that can be used for diagnostic purposes and also potentially as a theranostic for drug delivery.

METHOD AND MATERIALS

Materials and Methods: Human retinal endothelial cells (HREC’s) were grown in 2-D static and 3-D vascular mimic. The HRECs were exposed to lipopolysaccharide (LPS) and fluorescent antibodies were used to screen for expression of E-selectin, P-selectin, ICAM-1 and VCAM. Nanoconjugates (NCs) were prepared from a blend of phospholipid (DPPC and DPPE-PEG) using mechanical agitation to entrap perfluorobutane gas. The peptide DTWQDLWDLMK-OH was incorporated into the nanoconjugates via a PEG linker attached to lipids at a mole ratio = 1%. The peptide has a 4 nM KD for murine and human E-selectin. DiI was also incorporated into the NCs. Particle sizing was performed by QELS. Imaging studies were performed with fluorescence and high frequency ultrasound (VEVO) in the 2-D and 3-D phantoms and in rats with uveitis induced by LPS (n = 5 per group).

RESULTS

Results: E-selectin was markedly upregulated in inflamed HREC’s, >> than the other epitopes. The mean size of the NCs was < 1-micron. In vitro imaging showed marked accumulation of NCs on inflamed HRECs in conditions of flow; NCs bearing sham peptides showed no binding. The NCs were accumulated intracellularly by the inflamed HRECs. In vivo fluorescence and US imaging showed strong signal in inflamed eyes of the rats and no uptake in controls. Ex vivo study of the rat’s eyes showed intracellular uptake of NCs by inflamed retinal endothelial cells and adjacent macrophages.

CONCLUSION

Conclusion: NCs bearing this peptide are a promising agent for molecular ultrasound and fluorescence imaging of uveitis with strong binding to both human and rat/murine epitopes of E-selectin. Intracellular uptake of NCs by inflamed endothelial cells suggests theranostic potential as a platform for drug delivery.

CLINICAL RELEVANCE/APPLICATION

Because NCs work with both ultrasound and fluorescence and target a molecular marker of inflammation, NCs hold potential for better diagnosis and staging of uveitis. Intracellular uptake of NCs by inflamed cells shows potential for drug delivery.

Multispectral Optoacoustic Tomography (MSOT) for Therapy Monitoring of Arthritis

Reinhard Meier MD, PhD (Presenter): Nothing to Disclose, Nicolas Beziere: Nothing to Disclose, Claudio von Schacky: Nothing to Disclose, Moritz Wildgruber MD, PhD: Nothing to Disclose, Ernst J. Rummeny MD: Nothing to Disclose, Vasilis Ntziachristos PhD: Stockholder, iThera Medical GmbH

PURPOSE

We investigated the use of multispectral optoacoustic tomography (MSOT) in a murine model to monitor therapy effects of arthritic inflammation in vivo through an L- and P-selectin targeting contrast agent.

METHOD AND MATERIALS

This preclinical imaging study was performed using multispectral optoacoustic tomography (MSOT) able to record the optoacoustic signal detected by a cylindrically focus 64-elements transducer after illumination by a tunable pulsed laser in the near infra-red range (680-900 nm), yielding transverse images of entire mice in real time. A polyglycerol-sulfate grafted with near-infrared fluorophore was used (dPGS-ICG), allowing highlighting of the expression of L- and P-selectins, directly correlating to the state of inflammation of the joint and surrounding tissue. In twenty mice we induced arthritis by injection of collagen in one leg while keeping the other leg untouched as a healthy reference. These mice underwent MSOT and MR imaging at day 5, 35 and 42 after arthritis induction and simultaneous therapy onset. 10 mice were allocated to the therapy group receiving prednisolone and methotrexate, while 10 other mice served as controls treated with PBS. Data was processed using a model-based image reconstruction process followed by a least-square method spectral fitting. Clinical assessment of arthritis as well as ex vivo planar fluorescent imaging was used to validate the results obtained by imaging.

RESULTS

MSOT allowed clear identification of the probe over the anatomical signal. MSOT signal intensity directly and quantitatively correlated to the advancement of the disease in the joint. The findings matched well with MR imaging showing Gadolinium infiltration in the synovial fluid. Arthritic inflammation was significantly lower in the therapeutic compared to the control group (p<0.05) on day 35 and 42 after therapy onset as measured with MSOT and confirmed by MR imaging, clinical examination and histopathology.

CONCLUSION

MSOT allows for therapy monitoring of arthritic inflammation. In the future, we see this imaging method may help to determine treatment response in an early state. For non-responders earlier change in therapy strategy could lead to reduction of unnecessary side effects.

CLINICAL RELEVANCE/APPLICATION

Given the current development of the MSOT technology, it is expected that similar approaches will rapidly be translated in the clinic as a fast and relatively cheap staging procedure.
A Role of the 18-FDG-PET/CT in the Assessment of Sepsis of Uncertain Origin

Jiri Ferda MD, PhD (Presenter): Nothing to Disclose, Eva Ferdova MD : Nothing to Disclose, Jan Baxa MD, PhD : Nothing to Disclose

PURPOSE
To assess a role of the hybrid imaging with 18-FDG-PET/CT in detection of the cause of sepsis of uncertain origin

METHOD AND MATERIALS
In the sample of 42 adult patients (23 males, 29 females, mean age 43.7 y. ranging 24 - 81 y.), 18-FDG-PET/CT was referred due to the concurrent or recurrent septic state. The changes in the glucose metabolism related to the suspected site of infection were searched. All examinations were conducted after intravenous application of 18F-fluorodeoxyglucose in the dose of 4 MBq/kg of body weight and 60 minutes of radiopharmaceutical accumulation, all PET/CT scans were performed using three-ring-sixteen-slice system (Biograph 16 HR, Siemens, Knoxville, TN, USA) with the intravenous application of 80 ml of iodine contrast material with sub-millimeter spatial resolution. In all patients was investigated microbial infection agents using blood samples or the assessment of specimen taken from the site of focal infection.

RESULTS
The focal finding allowing detection of the origin of the septic state was found in 39 of 42 pts. (92.8%), three cases remained with undetermined cause of sepsis. Those most frequent sites of the hidden infection were found: spondylodiscitis in 30.7% (12/39), followed by musculoskeletal infection in 25.4% (10/39) including pyogenous arthritis (3 cases), psoatic abscess (2 cases) or joint prosthesis infection (5 cases); cardiovascular infection in 23.1% (9/39) including endocarditis (3 cases), pericarditis (one case), mycotic aneurysm (3 cases) and vascular prosthetic infection (2 cases). Other, less frequent causes of septic or septic-like state were gastrointestinal inflammation in 4 cases, lung infection in 3 cases and one case of Hodgkin lymphoma. The proven bacterial agents was in 37 cases - 16 cases of staphylococcal (including 7 cases of methiciline resistant streptococcus aureus and 5 cases of methiciline sensitive streptococcus aureus); 6 cases of streptococcal; 13 cases of Gramm negative bacterial and 2 cases of mycobacterial infection.

CONCLUSION
18-FDG-PET/CT reached the sufficient efficiency in detection of the origin of sepsis in patient with uncertain site of infection; the spondylodiscitis is the most frequent finding in septic state.

CLINICAL RELEVANCE/APPLICATION
18-FDG-PET/CT is reaching the positive results in more than 90% cases of referred patients allowing the subsequent targeted therapy.

SSG09
ISP: Musculoskeletal (Muscle to Tendon - Sports and Clinical Practice)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 10:30 AM - 12:00 PM Location: E450B

Participants
Moderator
Michael Paul Recht MD : Nothing to Disclose
Moderator
Craig William Walker MD : Nothing to Disclose

Sub-Events
SSG09-01
Musculoskeletal Keynote Speaker: Muscle to Tendon—Structure and Mechanism Dictate Patterns of Injury
David Alan Rubin MD (Presenter): Nothing to Disclose

SSG09-03
Magnetic Resonance Imaging (MRI) of Muscle Strains of the Thigh in Professional Soccer players: Correlation of Imaging Findings with the Duration of Convalescence and Presentation at Return to Play
Marc Regier (Presenter): Nothing to Disclose, Cyrus Behzadi : Nothing to Disclose, Frank Oliver Gerhard Henes MD : Nothing to Disclose, Chressen Catharina Remus MD : Nothing to Disclose, Gerhard B. Adam MD : Nothing to Disclose, Philip Catala-Lehnen : Nothing to Disclose

PURPOSE
To determine the prognostic value of MRI for the estimation of the rehabilitation period after thigh muscle injury.
To determine the prognostic value of MRI for the estimation of the rehabilitation period after thigh muscle injury in professional soccer players and to evaluate imaging findings at return-to-play (RTP).

**METHOD AND MATERIALS**

During three consecutive seasons 87 thigh muscle injuries were examined at 3T MRI in 47 players of the highest professional level. The predefined imaging protocol included coronal and transversal T2w STIR, T2w TSE, DWI and T1w TSE sequences. Identical scans were performed the day after the injury occurred and on the day of RTP. All MRI data sets were independently read by two blinded radiologists and muscle injuries were graded applying Peetrons classification system (grade 0-3). Additionally, transversal area measurements of the muscle were performed and the percentage of the affected portion was recorded reading T2w and DWI images at the time of injury and RTP. The grade of muscle injury and the affected transversal muscle area were correlated to the duration of the rehabilitation period. Statistical analysis included Wilcoxon-matched-pairs and Chi-square test.

**RESULTS**

Muscle injuries were assigned grade 0 in 4.6% (4/87), grade 1 in 64.3% (56/87), grade 2 in 27.6% (24/87) and grade 3 in 3.4% (3/87). The mean duration of the rehabilitation correlated well with the severity of injury in all grades (grade 0, 6 days; grade 1, 12 days; grade 2, 20 days; grade 3, 46 days; p

**CONCLUSION**

In professional soccer players, MRI based grading and transversal area measurements of thigh muscle injury strongly correlate with the duration of convalescence and can be used to estimate players time of absence. Even at relief of symptoms and return to maximum physical exertion a decreasing though persistently elevated signal at fluid-sensitive T2w and DWI MRI can frequently be observed.

**CLINICAL RELEVANCE/APPLICATION**

MRI can be referred to as a valuable tool in the prognostication of thigh muscle injuries in professional soccer players, however, normalisation of imaging findings is not mandatory for return to play.

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**SSG09-04**


Michel D. Crema MD (Presenter): Shareholder, Boston Imaging Core Lab, LLC, Ali Guermazi MD, PhD: President, Boston Imaging Core Lab, LLC Research Consultant, Merck KgaA Research Consultant, Sanofi-Aventis Research Consultant, TissueGene, Inc, Johannes Tol MD, PhD: Nothing to Disclose, Jingbo Niu: Nothing to Disclose, Bruce Hamilton: Nothing to Disclose, Frank W. Roemer MD: Chief Medical Officer, Boston Imaging Core Lab LLC Research Director, Boston Imaging Core Lab LLC Shareholder, Boston Imaging Core Lab LLC

**PURPOSE**

To describe in detail the anatomic distribution of acute hamstring injuries in soccer players, including which muscles are affected and the locations of the injuries within each muscle, and to assess the relationship between location and extent of edema and tears (fiber disruption), all based on findings from MRI.

**METHOD AND MATERIALS**

We included 275 consecutive male soccer players who had sustained acute hamstring injuries and had positive findings on MRI. For each subject, lesions were recorded according to the presence of typical MRI features in specific locations (and groups of locations) of the hamstring muscles, which were divided into proximal or distal: Free tendon, myotendinous junction locations, muscle belly locations, and myofascial junction locations. For each lesion, we assessed the largest cross-sectional area of edema and/or tears (when present). We calculated the prevalence of injuries by location. The average value of edema and tears for each hamstring muscle was determined, considering the whole sample, and used as the reference standard. The relationships between locations and extent of edema and tears were assessed using a one-sample t-test, with significance set at p<0.05.

**RESULTS**

The sample included 393 lesions. The long head of biceps femoris (LHBF) was the most commonly affected muscle (56.5%). Overall, injuries were most common in the myotendinous junction and in proximal locations. The proximal myotendinous junction was associated with a greater extent of edema in the LHBF and semitendinosus muscles (p<0.05). Proximal locations in the LHBF had larger edema than distal locations (p<0.05). Distal locations in the semitendinosus muscle had larger tears than proximal locations (p<0.05).

**CONCLUSION**

The proximal myotendinous junction and proximal locations in general are more commonly affected and are associated with a greater extent of edema in acute hamstring muscle injury. Distal locations, however, seem to be associated more with larger tears.

**CLINICAL RELEVANCE/APPLICATION**

Knowledge of the findings and relationships between hamstring muscle injury location and extent of edema and tears could potentially give useful prognostic information and guide physicians in the management of the injured athletes, since previous studies have shown that the extent of injury is associated with important clinical features such as time of recovery and risk of re-injury.

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**SSG09-05**

**Prevalence of Sciatic Nerve Abnormalities in the Setting of Hamstring Injuries**

**SSG09-04**


Michel D. Crema MD (Presenter): Shareholder, Boston Imaging Core Lab, LLC, Ali Guermazi MD, PhD: President, Boston Imaging Core Lab, LLC Research Consultant, Merck KgaA Research Consultant, Sanofi-Aventis Research Consultant, TissueGene, Inc, Johannes Tol MD, PhD: Nothing to Disclose, Jingbo Niu: Nothing to Disclose, Bruce Hamilton: Nothing to Disclose, Frank W. Roemer MD: Chief Medical Officer, Boston Imaging Core Lab LLC Research Director, Boston Imaging Core Lab LLC Shareholder, Boston Imaging Core Lab LLC

**PURPOSE**

To describe in detail the anatomic distribution of acute hamstring injuries in soccer players, including which muscles are affected and the locations of the injuries within each muscle, and to assess the relationship between location and extent of edema and tears (fiber disruption), all based on findings from MRI.

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We included 275 consecutive male soccer players who had sustained acute hamstring injuries and had positive findings on MRI. For each subject, lesions were recorded according to the presence of typical MRI features in specific locations (and groups of locations) of the hamstring muscles, which were divided into proximal or distal: Free tendon, myotendinous junction locations, muscle belly locations, and myofascial junction locations. For each lesion, we assessed the largest cross-sectional area of edema and/or tears (when present). We calculated the prevalence of injuries by location. The average value of edema and tears for each hamstring muscle was determined, considering the whole sample, and used as the reference standard. The relationships between locations and extent of edema and tears were assessed using a one-sample t-test, with significance set at p<0.05.

**RESULTS**

The sample included 393 lesions. The long head of biceps femoris (LHBF) was the most commonly affected muscle (56.5%). Overall, injuries were most common in the myotendinous junction and in proximal locations. The proximal myotendinous junction was associated with a greater extent of edema in the LHBF and semitendinosus muscles (p<0.05). Proximal locations in the LHBF had larger edema than distal locations (p<0.05). Distal locations in the semitendinosus muscle had larger tears than proximal locations (p<0.05).

**CONCLUSION**

The proximal myotendinous junction and proximal locations in general are more commonly affected and are associated with a greater extent of edema in acute hamstring muscle injury. Distal locations, however, seem to be associated more with larger tears.

**CLINICAL RELEVANCE/APPLICATION**

Knowledge of the findings and relationships between hamstring muscle injury location and extent of edema and tears could potentially give useful prognostic information and guide physicians in the management of the injured athletes, since previous studies have shown that the extent of injury is associated with important clinical features such as time of recovery and risk of re-injury.
PURPOSE

To determine the prevalence of sciatic nerve abnormalities on MRI in the setting of acute and chronic hamstring tears.

METHOD AND MATERIALS

IRB approval was obtained and informed consent was waived. We searched our PACS system for MRI of the hamstrings performed between January 2011 and November 2013, and identified 168 patients with either acute or chronic tears. We then reviewed the images of these patients and identified a cohort in which the sciatic nerve looked abnormal, and correlated these findings with clinical notes from the office visits of these patients. MRI was performed using either a 1.5 or 3T magnet (GE Healthcare) with a cardiac or body coil. The protocol included coronal and axial inversion recovery and proton density sequences. Initial image interpretation was performed by any 1 of 11 fellowship-trained musculoskeletal (MSK) radiologists. An MSK fellow then reviewed all of the MRI examinations to confirm the findings. The hamstring tears were characterized as partial or complete and acute/subacute or chronic. Partial tears were further subclassified as low, moderate or high grade.

The sciatic nerve was evaluated for abnormalities in signal and morphology, and for extrinsic compression. Neither the original MSK radiologist reading the case nor the MSK fellow knew which patients had clinical findings of sciatica in all but 2 cases.

RESULTS

47 of the 168 cases of hamstring tear (28%) had MRI features of sciatic nerve abnormality/compression. 36/47 (77%) had acute/subacute hamstring tears and 11/47 (23%) had chronic tears. 29/47 (62%) were full thickness tears and 18/47 (38%) were partial thickness. Clinically, only 10/47 had symptoms referable to the sciatic nerve (21%), 6 of which were associated with an acute/subacute hamstring tear and the other 4 with a chronic tear. 7 of the 10 clinically symptomatic cases were associated with full thickness tears and 3 were associated with low to moderate grade partial thickness tears.

CONCLUSION

The sciatic nerve may look abnormal in almost a third of hamstring injury cases, and yet is clinically symptomatic in only one-fifth of those abnormal appearances.

CLINICAL RELEVANCE/APPLICATION

The sciatic nerve may look abnormal on MR imaging of hamstring tears, but is usually not clinically symptomatic.

SSG09-06

Infraspinatus Tendon Tears with an Intact Footprint: Imaging Features and Anatomic and Clinical Relevance

Brady Kirk Huang MD (Presenter): Nothing to Disclose, Eric Y. Chang MD: Nothing to Disclose

PURPOSE

We aim to describe the imaging features of infraspinatus tendon tears that occur adjacent to an intact footprint. Isolated injuries of the infraspinatus tendon have been designated in the literature as a 'novel lesion' from a tendon versus myotendinous injury (Lunn JV, et al. J Shoulder Elbow Surg. 2008). Based on retrospective review of our own cases, we postulate that these injuries may be related to a layered anatomy of the infraspinatus tendon, with a superficial (transverse) tendon inserting onto a deeper (oblique) tendon, the latter of which inserts on the greater tuberosity (Kato A et al. Surg Radiol Anat. 2012).

METHOD AND MATERIALS

This retrospective chart review study was performed performed over a 3 year period from January 2010 to December 2012. A key word search for the term "novel lesion" was applied to the search algorithm, as we began to document these cases in our reporting lexicon. MR images of all patient were retrospectively reviewed in addition to the clinical and surgical data, if available.

RESULTS

The average age at presentation was 50.8 years (range=24.2-69.3). 2 patients had a traumatic fall prior to presentation and 8 recalled a single event that lead to symptoms, such as lifting or throwing. The remaining 7 patients presented with pain without preceding injury. All patients showed myotendinous junction edema of the infraspinatus muscle and variable degrees of retraction of bursal-sided fibers, with an intact footprint. 8 patients eventually underwent arthroscopic surgery with an average time of 116 days from initial presentation. Average follow-up time after surgery was 141.8 days. Tendon repairs were performed in 6 patients and debridement in 2 patients. Only 2 patients shows bursal-sided tendon tearing potentially corresponding to the MRI. One repair failed. 3 patients underwent follow-up MRI, with 2 showing progression of infraspinatus muscle atrophy.

CONCLUSION

Partial tears of the infraspinatus tendon, especially when affecting the bursal surface fibers with an intact footprint, are likely the result of delamination of the superior (transverse) part from the inferior (oblique) part of the tendon, resulting in characteristic imaging appearances.

CLINICAL RELEVANCE/APPLICATION
Infraspinatus tendon injuries with an intact footprint are unusual injuries with a characteristic imaging appearance, and may be missed on arthroscopy, even when prospectively identified on pre-operative imaging.

SSG09-07

Biceps Femoris Tendon and Lateral Collateral Ligament: Analysis of Insertion Pattern Using MRI

Yunkyung Shin (Presenter): Nothing to Disclose, Kyung Nam Ryu MD, PhD: Nothing to Disclose, Ji Seon Park MD, PhD: Nothing to Disclose, Wook Jin: Nothing to Disclose, So Young Park: Nothing to Disclose

PURPOSE

Biceps femoris tendon (BFT) and lateral collateral ligament (LCL) in knee were formerly known to form a conjoined tendon at fibular attachment site. However, biceps femoris tendon lateral collateral ligament insert into the fibular head in a variety of patterns. Understanding of such anatomical variance would help to reduce misdiagnoses in the corresponding area. We classified insertion patterns of BFT and LCL using MR imaging, and analyzed whether LCL attaches to fibular head or not.

METHOD AND MATERIALS

A total of 494 consecutive knee MRIs of 470 patients taken between July 2012 and December 2012 were retrospectively reviewed. There were 224 males and 246 females, and the patient age varied from 10 to 88 (mean, 48.6). The exclusion criteria were previous surgery and poor image quality. Using 3T fat-suppressed proton density-weighted axial images, fibular insertion patterns of BFT and LCL were classified into the following types: type I (LCL passes between anterior arm and direct arm of long head of BFT), type II (LCL joins with anterior arm of long head of BFT), type III (BFT and LCL join to form a conjoined tendon), type IV (LCL passes laterally around the anterior margin of BFT), and type V (LCL passes posteriorly to the direct arm of long head of BFT).

RESULTS

Among the 494 cases of knee MRI, there were 433 (87.65%) type I cases, 21 (4.25%) type II cases, 2 (0.4%) type III cases, 16 (3.23%) type IV cases, and 22 (4.45%) type V cases. There were 26 cases (5.26%) in which LCL and BFT did not insert into fibular head.

CONCLUSION

Only a small fraction of subjects showed a conjoined tendon at fibular insertion of BFT and LCL. Fibular attachment pattern of BFT and LCL shows various types in MR imaging. Lateral collateral ligaments do not insert into the fibular head in some patients.

CLINICAL RELEVANCE/APPLICATION

An understanding of insertion pattern of BFT and LCL will be helpful to evaluate tendons in reading knee MRIs.

SSG09-08

Gastrocnemius Tendinosis- An Overlooked Finding on Knee MRI Examinations

Anugayathri Jawahar MBBS, MD (Presenter): Nothing to Disclose, Yanan Lu MD: Nothing to Disclose, Gokcan Okur MD: Nothing to Disclose, Laurie McAdams Lomasney MD: Consultant, Amirsys, Inc

PURPOSE

Gastrocnemius tendinosis (GT) is one potential cause for posterior knee pain, commonly overlooked on clinical examinations and imaging. Tendinosis/tendinopathy is frequently due to chronic repetitive micro trauma to muscle/tendon complex. There is little mention about GT in literature. This study assesses the frequency of GT on MR imaging and potential associated articular pathologies or clinical association.

METHOD AND MATERIALS

With IRB approval, retrospective review was done on randomly selected 300 MR knee exams performed from February 2009 to June 2010. Following de-identification, axial T2 and sagittal PD images, with or without fat suppression were reviewed by 2 radiologists. The gastrocnemius tendon femoral attachments were graded as normal, mild (few cysts, thickening, intermediate signal) or severe GT (multiple cysts, marrow edema, tear). Select associated MR findings of internal derangement were documented. Clinical charts were reviewed for clinical presentation, physical exam findings, and select demographics including age, gender, BMI, occupation and recreational activities.

RESULTS

The inter-observer reliability for presence/grading of GT very high (kappa statistic=0.97). Frequency of GT was 50.33%, most frequently medial head of gastrocnemius (63.6%). Grades of GT were 41.7% and 17.2% for mild and severe respectively. Univariate analysis showed statistically significant relationship between grade of GT with arthrosis (p=0.05) and clinical joint effusion (p=0.02). Multivariate analysis showed significant probability odds for medial plus lateral GT when effusion and posterior knee pain are present, and significant but decreased probability for isolated medial GT. Statistical significance was seen between GT and ACL tear
(13.9%; p=0.02) but not for medial meniscal tear, popliteal cyst and chondrosis. Mean age for GT patients was 50.4 years, older than those without (p=<0.001). BMI and gender showed no statistically significant difference between with and without GT.

CONCLUSION

Gastrocnemius tendinosis is an under-reported finding on MR knee examinations. Increased understanding of frequency of GT allows more accurate reporting of MR knee exam and systematic search for associated abnormalities.

CLINICAL RELEVANCE/APPLICATION

Awareness of gastrocnemius tendinosis enhances knee MR interpretation, especially in setting of posterior knee pain, and can assist clinical management.

Edema between the Sartorius/Gracilis Tendons and Posteromedial Femoral Condyle: Description of a New Friction Syndrome in the Knee

Frank J. Simeone MD (Presenter): Nothing to Disclose, Ambrose J. Huang MD : Nothing to Disclose, Maximilian Smith : Nothing to Disclose, Connie Y. Chang MD : Nothing to Disclose, Miriam Antoinette Bredella MD : Nothing to Disclose, Martin Torriani MD : Nothing to Disclose

PURPOSE

Medial joint line pain in the knee is often secondary to meniscal tears or osteoarthritis. The purpose of this study is to describe a new cause of medial knee pain, characterized by edema between the gracilis/sartorius tendons and medial femoral condyle (MFC).

METHOD AND MATERIALS

The study group comprised 31 patients with findings of edema between the sartorius/gracilis tendons and the posteromedial femoral condyle (mean age 36.6±8.5 years, 29 female, 1 male, BMI 22.9±3.3) and 27 age- and gender-matched controls. Cases were reviewed by two subspecialist radiologists with 2 and 17 years of experience for soft tissue findings, distance between gracilis tendon and medial femoral condyle, distance between sartorius tendon and MFC, knee flexion angle, position of gracilis tendon with respect to sartorius and presence or absence of related findings including Baker's cyst and pes anserine bursitis. Clinical notes were reviewed and history and physical exam data were recorded.

RESULTS

Study patients with findings of edema demonstrated significantly lower BMI (P<0.05) and distance between the gracilis tendon and MFC (p<0.05) compared to controls. There was no significant difference between age, sartorius distance, knee flexion angle or other incidental findings in the knee. Study patients were often mistaken for medial meniscus tears clinically (70%). Ultrasound guided steroid and anesthetic injection of the MRI-identified area of edema between tendons and MFC resulted in immediate and up to 2 months of pain relief in 2 subjects.

CONCLUSION

MRI findings of focal soft tissue edema between the sartorius/gracilis tendons and medial femoral condyle represents a clinical syndrome of knee medial joint line pain. Subjects are more likely to be female, have lower BMI and closer position of the gracilis tendon relative to the MFC.

CLINICAL RELEVANCE/APPLICATION

This study describes a new cause of medial joint line pain with reproducible clinical and imaging findings which should be considered on the differential of medial sided pain.
SSG10-01  Lifetime Attributable Risk of Cancer from Radiation Exposure during Parathyroid Imaging: Comparison of 4DCT and Sestamibi Scintigraphy

Jenny K. Hoang MBBS (Presenter): Nothing to Disclose, Robert E. Reiman MD: Nothing to Disclose, Giang Huong Nguyen MD, PhD: Nothing to Disclose, Natalie Januzis: Nothing to Disclose, Carolyn R. Lowry BS: Nothing to Disclose, Bennett B. Chin MD: Nothing to Disclose, Terry T. Yoshizumi PhD: Nothing to Disclose

PURPOSE

The aim of this study was to measure the effective dose and organ doses for parathyroid 4DCT and sestamibi scintigraphy, and to estimate the lifetime attributable risk (LAR) of cancer incidence based on the measured radiation doses.

METHOD AND MATERIALS

We measured the organ radiation doses for 4DCT and sestamibi scintigraphy (with SPECT-CT) based on scanning with our institution’s protocols. An anthropomorphic phantom with MOSFET detectors was scanned to measure radiation dose from CT. Organ doses from the radionuclide for scintigraphy were based on NUREG/CR-6345. Effective dose was calculated for 4DCT and scintigraphy, and used to estimate the LAR of cancer incidence for patients differing in age and gender with the approach established by the Biologic Effects of Ionizing Radiation VII report. A 55-year-old female was selected as the standard patient based on demographics of patients with primary hyperparathyroidism.

RESULTS

The organs that received the highest radiation dose for 4DCT were the thyroid (150 mGy), salivary glands (137 mGy) and the esophagus (87 mGy). For sestamibi scintigraphy, the highest organ doses were to the colon (42 mGy), gall bladder (35 mGy) and the kidneys (32 mGy). The effective dose was 26 mSv for 4DCT compared to 12 mSv for sestamibi scintigraphy. The baseline lifetime incidence of any cancer in the unexposed standard patient was 46438/100,000. In the exposed patient, the LAR for cancer incidence was 172/100,000 for 4DCT and 66/100,000 for sestamibi scintigraphy. This resulted in an increase in lifetime incidence of cancer over baseline risk of 0.46% for 4DCT and 0.18% for sestamibi scintigraphy. In a 25-year-old female (nonstandard) the increase in the lifetime incidence of cancer over baseline risk was higher at 0.94% for 4DCT and 0.36% for sestamibi scintigraphy.

CONCLUSION

Effective dose from 4DCT is double that of sestamibi scintigraphy, but both studies cause negligible increases in lifetime risk of cancer. Clinicians should not allow concern for radiation-induced cancer influence decisions regarding workup in older patients with primary hyperparathyroidism. In younger women, 4DCT should not be the first-line imaging modality given a substantially higher LAR from 4DCT compared to scintigraphy.

CLINICAL RELEVANCE/APPLICATION

Clinicians should not allow concern for radiation-induced cancer influence decisions regarding workup in older patients (≥ 55 years) with primary hyperparathyroidism.

SSG10-03  TIRADS and Ultrasound Elastography: Useful Tools in Recommending Repeat FNA for Solid Thyroid Nodules with Nondiagnostic Fine Needle Aspiration Cytology

Vivian Youngjean Park MD (Presenter): Nothing to Disclose, Eun-Kyung Kim: Nothing to Disclose, Jin Young Kwak MD: Nothing to Disclose, Jung Hyun Yoon MD: Nothing to Disclose, Hee Jung Moon MD: Nothing to Disclose

PURPOSE

We aimed to evaluate the role of the thyroid imaging reporting and data system (TIRADS) and elastography in recommending repeat fine-needle-aspiration (FNA) for solid thyroid nodules with nondiagnostic FNA cytology.

METHOD AND MATERIALS

A total of 143 solid thyroid nodules in 141 patients were included. Each was classified according to the TIRADS; solid component, hypoechogenicity or marked hypoechogeticity, microlobulated or irregular margins, microcalcifications, and taller-than-wide shape were considered suspicious US features. Nodules with one, two, three or four, or five suspicious US features were classified as category 4a, 4b, 4c or 5 respectively. Elastography scores were classified according to the Rago and Asteria criteria. We investigated the malignancy risk for each TIRADS category and the corresponding sensitivity, specificity, negative predictive value, positive predictive value, and accuracy of elastography.

RESULTS

Of 141 nodules, 25 were malignant, 79 were benign, and 39 were not confirmed. None of the US features, frequencies of TIRADS categories or classification according to the Rago and Asteria criteria significantly differed between benign and malignant nodules. The malignancy risk for TIRADS category 4a, 4b, 4c and 5 were 6.7% (1/15), 15.8% (6/38), 20.7% (17/82) and 12.5% (1/8) respectively, when including nonconfirmed nodules in the denominator. When analyzing confirmed nodules, elastography showed the highest negative predictive value for TIRADS category 4a; sensitivity, specificity, negative predictive value, positive predictive value and accuracy were 0% (0/1), 85.7% (6/7), 85.7% (6/7), 0% (0/1), 75% (6/8) for the Rago criteria and 100% (1/1), 85.7% (6/7), 100 (6/6), 50% (1/2) and 87.5% (7/8) for the Asteria criteria. The Asteria criteria accurately classified the 1 malignant nodule in the TIRADS category 4a as malignant.
CONCLUSION

Observation may be considered for solid thyroid nodules with nondiagnostic cytology that are classified as TIRADS category 4a and benign based on Asteria criteria, due to their low malignancy risk and high negative predictive value of elastography. Repeat FNA is warranted for TIRADS category 4b, 4c or 5, regardless of elastography features.

CLINICAL RELEVANCE/APPLICATION

Elastography is a useful tool in recommending repeat FNA for solid thyroid nodules with initial nondiagnostic cytology, when no other suspicious US features are present.

Ultrasound Elastography Using Carotid Artery Pulsation in Differential Diagnosis of Sonographically Indeterminate Thyroid Nodules

Bongguk Yim (Presenter): Nothing to Disclose, Woo Jung Choi MD: Nothing to Disclose, Jeong Seon Park MD: Nothing to Disclose, Hye Ryoung Koo MD: Nothing to Disclose, Soo-Yeon Kim: Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the diagnostic performance of gray-scale ultrasound (US) and a new method of thyroid US elastography using carotid artery pulsation in the differential diagnosis of sonographically indeterminate thyroid nodules.

METHOD AND MATERIALS

A total of 102 thyroid nodules with indeterminate gray-scale US features from 102 patients (20 men and 82 women; age range, 16-74 years, mean age: 51 years) were included. Gray-scale US images were reviewed and scored from 1 (low) to 5 (high) according to the possibility of malignancy. US elastography was performed using carotid pulsation as a compression source. The elasticity contrast index (ECI), which quantifies local strain contrast within a nodule, was automatically calculated. The radiologist reassessed scores after concurrently reviewing gray-scale US and elastography. Receiver operating characteristic curve analysis was used to evaluate the diagnostic performances of each data set and to compare the Az values of gray-scale scoring, ECI, and combined assessment scoring.

RESULTS

Malignant thyroid nodules were more hypoechoic than benign nodules. The ECI was significantly higher in malignant nodules than in benign thyroid nodules. The Az values of each data set were 0.755 (95% CI, 0.660-0.835) for gray-scale, 0.835 (95% CI, 0.748-0.901) for ECI, and 0.853 (95% CI, 0.769-0.915) for combined assessment. The Az value for the combined assessment of gray-scale and ECI was significantly higher than for gray-scale alone (p = 0.022).

CONCLUSION

Combined assessment with gray-scale US and elastography using carotid artery pulsation is helpful for differentiating sonographically indeterminate thyroid nodules.

CLINICAL RELEVANCE/APPLICATION

Thyroid US elastography using carotid artery pulsation may be a useful adjunctive parameter for the differential diagnosis of sonographically indeterminate thyroid nodules.

Parathyroid Adenomas and Hyperplasia on 4DCT: Grading System for Degree of Confidence

Manisha Bahl MD, MPH (Presenter): Nothing to Disclose, Ali R. Sepahdari MD: Nothing to Disclose, Julie A. Sosa MD: Nothing to Disclose, Jenny K. Hoang MBBS: Nothing to Disclose

PURPOSE

Prior to performing minimally-invasive parathyroidectomy, preoperative imaging is required to localize parathyroid adenomas with a high degree of confidence. Several signs on 4DCT can be used to determine degree of confidence. The purpose of this study is to evaluate the performance of a confidence grading system for parathyroid lesions on 4DCT.

METHOD AND MATERIALS

We retrospectively reviewed preoperative 4DCT scans in 63 consecutive patients from November 2012 to December 2013 with pathologically-proven parathyroid adenomas or hyperplasia. Two radiologists reviewed the CT images to localize parathyroid lesions. Lesions detected on imaging and confirmed by surgery were categorized by a three-category confidence grading system based on four enhancement patterns (Types A-D) and three secondary signs. "Consistent with" was defined as Type A/B enhancement with >/= 1 secondary findings. "Suspicious" was defined as Type A/B enhancement without secondary findings or Type C/D enhancement with
"Possible" was Type C/D enhancement without secondary findings. The enhancement patterns required the lesion to be lower in attenuation than the thyroid gland on the noncontrast phase but differed on the arterial and delayed phases. Secondary findings were size $\geq 1$ cm, a cystic component, and the polar vessel sign. We calculated and compared the prevalence and positive predictive values (PPV) of each grading system category.

RESULTS

63 patients had 75 lesions. 54 patients had single adenomas and nine patients had multigland disease with 21 lesions. The sensitivities for single gland and multigland disease were 94% and 52%, respectively. 74 lesions (including four false positives) could be categorized by the grading system. "Consistent with" was seen in 51% of lesions and had 100% PPV. "Suspicious" represented 37% of lesions and had 96% PPV. Finally, "possible" represented 11% of lesions and had the lowest PPV (73%).

CONCLUSION

A grading system allows radiologists to communicate the degree of confidence when a lesion is detected on 4DCT, which is valuable for preoperative planning. The proposed system performs as intended in that the highest confidence grade has the highest PPV and the lowest grade has the lowest PPV.

CLINICAL RELEVANCE/APPLICATION

A 4DCT grading system can communicate degree of confidence for parathyroid adenomas, and detection of a lesion with the highest confidence grade may reduce the need for further imaging.

SSG10-06

Intra-reader Agreement for Color Based Elastograms in Thyroid Elastography

Manjiri K. Dighe MD (Presenter): Research Grant, General Electric Company, Jeff Thiel: Nothing to Disclose, Theodore J. Dubinsky MD: Nothing to Disclose

PURPOSE

To assess intra-reader agreement in evaluation of the color elastograms in thyroid elastography using Shear-Wave elastography

METHOD AND MATERIALS

After IRB approval, elastograms were obtained by Shear-wave elastography from 77 individuals, with a total of 96 thyroid nodules. Elastography data was acquired without any external compression using the Supersonics Aixplorer machine. Each nodule had multiple color elastograms saved per nodule. 1 reader blinded to the final cytopathology results was asked to score the elastogram images based on a standard 5-point scale. The reader was then asked to rescore the elastograms after a period of 15 days and was also blinded to the prior results. Results were also compared to the cytopathology diagnosis based on Bethesda classification. In addition, since each nodule had multiple images, variability of scoring within a single nodule was also evaluated.

RESULTS

There was overall good intra-reader agreement in scoring the elastograms with a concordance correlation coefficient of 0.83, a weighted kappa of 0.71 with a 95% confidence interval of 0.66 to 0.76 and a mean Intraclass correlation coefficient (ICC) of 0.83 and 0.90. The Area under the curve for accurate diagnosis of the nodule as being benign or malignant was 0.82. The variability in the scoring between the benign nodules was less than that in the malignant nodules with a variance of 0.64 and 1.38 respectively.

CONCLUSION

Our study indicates that there was good overall intra-reader agreement for qualitative scoring of the elastograms. The overall variance in the scoring of benign nodules was less than that in the malignant nodules. There could be bias in this since the number of malignant nodules in our study was smaller than benign nodules. Since Shearwave elastography provides quantitative values for the stiffness in the nodule, there would be less of a discordance and less variance compared to scoring color elastograms for thyroid nodule elastography.

CLINICAL RELEVANCE/APPLICATION

Decreasing the intra-reader variability in thyroid elastography is important. We also evaluated the variance in scoring each individual nodule since in every exam multiple images are acquired per nodule and it is important to know which particular score should be assigned to a nodule to be able to provide accurate diagnosis.

SSG10-07

Preoperative Differentiation of Thyroid Adenomas and Thyroid Carcinomas Using High Resolution Contrast-enhanced Ultrasound (CUE)

Ernst Michael Jung MD (Presenter): Nothing to Disclose, Stefan Schleder MD: Nothing to Disclose, Lena Dendl: Nothing to Disclose, Christian Roland Stroszczyński MD: Nothing to Disclose

PURPOSE

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PURPOSE

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CLINICAL RELEVANCE/APPLICATION

Decreasing the intra-reader variability in thyroid elastography is important. We also evaluated the variance in scoring each individual nodule since in every exam multiple images are acquired per nodule and it is important to know which particular score should be assigned to a nodule to be able to provide accurate diagnosis.
To evaluate the impact of high-resolution contrast-enhanced ultrasound (CEUS) in combination with Color Coded and Power Doppler Sonography (CCDS/PD) in the preoperative differentiation of thyroid adenomas and thyroid carcinomas.

**METHOD AND MATERIALS**

A total of 111 patients (60 female, median age 54 years) underwent surgery for thyroid adenoma and thyroid carcinoma. CCDS/PD and CEUS were performed in all patients by an experienced examiner using amultifrequency linear transducer (6-9 MHz) and were digitally stored. Reading of the ultrasound images was performed by two experienced radiologists in consensus. For CEUS a bolus injection of 1 ml Sulfurhexafluoride-Microbubbles (SonoVue®) was used. A histopathological evaluation was obtained as standard of reference in all patients.

**RESULTS**

80 thyroid adenomas and 31 thyroid carcinomas were detected. Mean diameter of thyroid adenomas and thyroid carcinomas was 27 mm and 25 mm, respectively. The differences in microcirculation of thyroid adenomas and thyroid carcinomas were statistically highly significant (p <0.01). Representative features for thyroid adenomas were either no wash-out or wash-out with persisting edge in late phase, for thyroid carcinomas a complete wash-out in late phase. Thus, calculation of the sensitivity, specificity, positive and negative predictive value of 82%, 91%, 96% and 63%, respectively, for the differentiation of benignity and malignancy was possible.

**CONCLUSION**

Dynamic evaluation of microcirculation using CEUS and CCDS/PD enables a more reliable preoperative discrimination between thyroid adenomas and thyroid carcinomas.

**CLINICAL RELEVANCE/APPLICATION**

CEUS enables a more reliable preoperative discrimination between thyroid adenomas and thyroid carcinomas.

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**SSG10-08**

**Dual-energy Multiphasic CT Scan for Localization of Discrepant or Unlocalized Parathyroid Adenomas**

Reza Forghani MD, PhD (Presenter): Nothing to Disclose, Michael Roskies MD: Nothing to Disclose, Michael Hier MD: Nothing to Disclose, Alex Mlynarek: Nothing to Disclose, Mark Levental MD: Nothing to Disclose

**PURPOSE**

Accurate pre-operative localization of parathyroid adenomas (PAs) is essential for successful minimally invasive surgery, and is typically based on two concordant studies. 4-dimensional MDCT is increasingly used for localization of PAs. There are also isolated reports of dual-energy CT (DECT) for localization of PAs but no systematic evaluation of this technique. DECT has the potential to increase accuracy of PTA detection by enabling more accurate iodine content evaluation and to eliminate the need for an unenhanced scan, reducing radiation exposure. In this study, we evaluated the utility of multiphasic DECT for PA localization in a group of patients having discrepant or unidentified PAs.

**METHOD AND MATERIALS**

20 patients with primary hyperparathyroidism having either discrepant or unlocalized PAs underwent a multiphasic DECT in a 64-slice scanner (GE Discovery CT750HD). Scans were obtained at 25, 55, and 85 sec after injection of 80 mL of iopamidol at 3.5 mL/sec. DECT scans were reconstructed as 70 keV monochromatic images and source images transferred to a dedicated workstation for reconstruction of virtual monochromatic images. The scans were prospectively reviewed by 2 attending head and neck radiologists. The final results were compared with localization during minimally invasive surgery and histopathologic confirmation.

**RESULTS**

Out of 20 patients, 11 had negative and 9 discordant standard imaging. DECT identified PAs in 8 of 11 and 7 of 9 patients, respectively. Of the 15 PAs, 7 were prospectively identified as PA candidates but characterized as atypical, based on absence of rapid arterial phase enhancement and early washout and/or presence of internal low attenuation areas. 7 patients have so far undergone surgery, and DECT correctly localized the PA in 6 of 7 patients, for a total of 7 PAs (one patient had bilateral PAs).

**CONCLUSION**

3-phase DECT without an unenhanced scan can accurately localize PAs in a significant proportion of unlocalized or discrepant cases. Although perfusion characteristics are important, a high proportion of PAs lacked typical perfusion characteristics in this patient population but were identifiable based on other features.

**CLINICAL RELEVANCE/APPLICATION**

Multiphasic DECT without an unenhanced scan can accurately localize a significant number of PAs not localized by conventional imaging enabling successful minimally invasive surgery with reduced surgical exploration and associated patient morbidity.
**SSG10-09 4DCT in the Evaluation of Hyperparathyroidism: Predictors of Parathyroid Single Gland and Multigland Disease**

Ali R. Sepahdari MD (Presenter): Nothing to Disclose, Manisha Bahl MD, MPH: Nothing to Disclose, Jenny K. Hoang MBBS: Nothing to Disclose

**PURPOSE**

Parathyroid multigland disease (MGD) is a challenging problem for radiologists. Other lesions in the patient may be missed after the first lesion is detected because they are small or not suspected. We aim to compare 4DCT findings of single gland (SG) and MGD to identify findings that may predict MGD.

**METHOD AND MATERIALS**

We retrospectively reviewed 35 patients with MGD and 129 patients with SG lesions who had preoperative 4DCT scans at two institutions between September 2011 and December 2013. The following data were recorded: presurgical calcium and PTH levels, number of candidate lesions identified with 4DCT, and longest measurement of abnormal glands seen on CT. Parametric and non-parametric statistical tests were applied in order to determine features or combinations of features that could predict MGD.

**RESULTS**

Mean size of MGD was 8.8 mm and significantly smaller than mean size 11.8 mm for SG lesions (p < .001). MGD also had lower serum PTH (P = .03). Fisher’s exact test showed that identification of only 1 abnormal gland, versus no abnormal glands or multiple abnormal glands, was strongly predictive of single gland disease (P < .0001, likelihood ratio [LR] = 5). The finding of only 1 abnormal gland was 86% specific for single gland disease (14% missed MGD). Adding the requirement that the abnormal gland measure at least 10 mm in maximal dimension resulted in 94% specificity for SG disease (6% missed) (P < .0001, LR 8.5).

**CONCLUSION**

Identification of a single abnormal gland measuring at least 10 mm on 4DCT is highly specific for single gland disease. Conversely, when the candidate lesion is less than 1 cm, the radiologists should be more suspicious for MGD and review the scan closely for another lesion. This information can help radiologists to improve the sensitivity of future 4DCT interpretations for MGD.

**CLINICAL RELEVANCE/APPLICATION**

Improving the detection of MGD or raising suspicion for MGD to the surgeons allows for a more informed clinical management plan and appropriate selection of patients for minimally invasive surgery.

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**SSG11 Neuroradiology (Cognitive & Psychiatric Disorders)**

**Scientific Papers**

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

**Tue, Dec 2 10:30 AM - 12:00 PM  Location: N227AB**

**Participants**

Moderator:
Jody Lee Tanabe MD: Nothing to Disclose

Moderator:
John DeWitt Port MD, PhD: Nothing to Disclose

**SSG11-01 Age-related Brain Activity Difference during Arithmetic Testing: An fMRI Investigation**

Li Sun (Presenter): Nothing to Disclose, Jiliang Fang: Nothing to Disclose, Kuncheng Li MD: Nothing to Disclose

**PURPOSE**

To investigate the neural basis for aging effect on single-digit multiplication using functional magnetic resonance imaging (fMRI).

**METHOD AND MATERIALS**

Nineteen younger and twenty aged subjects were required to perform single-digit multiplication and control tasks in magnetic resonance (MR) scanner.
RESULTS

For behavioral measures, our results revealed no differences in two age groups in accuracy and reaction time (RT) performance. For fMRI analysis, single-digit multiplication, relative to detecting-zero, yielded multiple frontal, temporal and parietal activations for both younger and aged participants, however, aged adults exhibited more extensive activation in medial frontal areas and less extensive activation in temporal and parietal lobes as compared with younger adults. Direct group comparisons showed that aged adults exhibited greater activity in right and left supplementary motor area (SMA), and weaker activity in bilateral parahippocampal gyri together with a cluster in right middle temporal gyrus.

CONCLUSION

Our findings indicate that, healthy aged adults enhance control of fact retrieval in SMA to compensate the deficits in temporal lobe memory system. Moreover, our findings provide supportive evidence for posterior-anterior shift in aging (PASA) pattern in arithmetic problem solving domain.

CLINICAL RELEVANCE/APPLICATION

fMR can demonstrate the neural basis of cognitive alteration in normal aging and patient. It has the potential to diagnose neurodegenerative disease in early stage.

SGG11-02

Genetic Frontotemporal Dementia with TDP-43 Inclusions: Distinct Radiological Phenotypes between Patients with PGRN and C9ORF72 Mutations

Anne Bertrand MD, PhD (Presenter): Nothing to Disclose, Fatima Ameur MD: Nothing to Disclose, Paola Caroppo MD: Nothing to Disclose, Didier Dormont MD: Nothing to Disclose, Alexis Brice: Nothing to Disclose, Isabelle Le Ber: Nothing to Disclose, Olivier Colliot: Nothing to Disclose

PURPOSE

To study the MR phenotypes of the 2 most frequent genetic forms of frontotemporal dementia: PGRN and C9ORF72 mutations.

METHOD AND MATERIALS

2 readers retrospectively reviewed axial FLAIR and 3D T1 images of 27 patients with a genetic form of frontotemporal dementia: 17 patients with C9ORF72 mutation and 10 patient with PGRN mutation. The severity of FLAIR hyperintensity was rated using the Fazekas & Schmidt score. The type of FLAIR intensities was rated using a 3-level score: A- vascular type; B- vascular type predominating in the areas of atrophy; C- non vascular type. The presence of regional atrophy was scored as follow: presence or absence of an anteroposterior gradient of atrophy; presence or absence of a left-to-right or right-to-left gradient of atrophy.

RESULTS

Interrater agreement was moderate for Fazekas & Schmidt score (0.50 (0.16-0.68)) and was high for the type of FLAIR intensities (0.79 (0.56-0.91)), the presence of anteroposterior gradient of atrophy (0.76 (0.61-1)) and the presence of left-to-right or right-to-left gradient of atrophy (0.73 (0.52-0.94)) (weighted kappa tests). Atypical FLAIR hyperintensities (type B-C) were present in 90% of patients with PGRN mutation, while only 12% with C9ORF72 mutation. Asymmetrical anterior atrophy, characteristic of frontotemporal dementia, was present in 70% of patients with PGRN mutation, while only 18% of patients with C9ORF72 mutation.

CONCLUSION

Major phenotypic differences distinguish on brain MRI C9ORF72 and PGRN mutations, which are both related to frontotemporal dementia with TDP-43 inclusions. This result demonstrates that gene-related effects can overpass lesion-related effects in the phenotypic expression of frontotemporal dementias.

CLINICAL RELEVANCE/APPLICATION

In patients presenting with frontotemporal dementia, neuroradiologists should raise the possibility of a genetic form linked to PGRN mutation when atrophy is particularly marked, and associated with atypical FLAIR hyperintensities, predominating in the areas of atrophy.

SGG11-03

Cognitive Dysfunctional in Patients with Early Type 2 Diabetes: A Preliminary BOLD fMRI and MR Spectroscopy and DTI Study

Xiang Liu MD (Presenter): Nothing to Disclose, Wei Tian MD, PhD : Nothing to Disclose

PURPOSE

There are few studies about cognitive impairment in early type 2 diabetes using fMRI technique. To evaluate cognitive dysfunction in early type 2 diabetes patients with psychological tests and BOLD fMRI. To analyze MR spectroscopy change in prefrontal cortex (PFC) and white matter abnormal by DTI.

METHOD AND MATERIALS

Twenty-five patients with early type 2 diabetes mellitus and 15 demographically similar, healthy subjects were enrolled. A series cognitive function tests including Wechsler memory scale-revised(WMS-R) were assessed; DTI, Bold fMRI (using nback working memory task) and single-voxel MRS with TE 30 on bilateral PFC were performed. The statistic differences of psychological tests and MRS result between the two groups were
evaluated by SPSS. The fMRI data were analyzed by SPM2. DTI data were processed using FSL package, Tract-Based Spatial Statistics (TBSS) to detect the FA/MD group difference.

**RESULTS**

(1) Psychological tests showed that the scores of cognitive tests in diabetes group were significantly lower than those in control group. (2) fMRI examinations revealed that the activation pattern in diabetes group was similar with the control group, but less activation in prefrontal, parietal lobe. There was additional activation in right temporal lobe (including inferior temporal gyrus and parahippocampus gyrus) and anterior cingulate cortex in diabetes group. (3) MRS data showed that comparing with control group, Glx/(Cho+Cr) was significantly elevated in bilateral PFC; NAA/Cho, Glx/Cho, Glx/Cre were significantly elevated in the right PFC. Transit memory was negatively correlated with Glx/Cho ($F=-0.546$, $P$ value $=0.013$) and Glx/(Cr+Cho) ($F=-0.471$, $P$ value $=0.036$). (4) DTI: patients group showed significant MD increase in right temporal WM and right superior longitudinal fasciculus (SLF) and right anterior internal capsule; FA showed decrease trend in those area in patients group.

**CONCLUSION**

Advanced neuroimaging techniques could detect microstructure and functional abnormalities in type 2 diabetic patients with normal appearing on conventional MR. The hypofunction in PFC in fMRI, abnormal white matter connectivity in DTI, and Glx elevation in MRS correlated with cognitive memory dysfunction, and may reveal early pathophysiological process and corresponding compensation.

**CLINICAL RELEVANCE/APPLICATION**

Advance functional MRI technique could detect early brain cognitive damage in patient with type 2 diabetes.

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**SSG11-04 Episodic Memory Impairment in Systemic Lupus Erythematosus: Evidences of Thalamic Structures Involvement**

Nicolle Zimmermann : Nothing to Disclose , Diogo Goulart Correa MD : Nothing to Disclose , Tania Maria Netto PhD : Nothing to Disclose , Bernardo Canedo Bizzo MD (Presenter): Nothing to Disclose , Rochele Paz Fonseca : Nothing to Disclose , Emerson L. Gasparetto MD : Nothing to Disclose

**PURPOSE**

Episodic memory deficits in systemic lupus erythematosus (SLE) have been frequently reported, but little is known about the neural correlates of these deficits. In this scenario, studies have been indicating lack of involvement of hippocampal volume associated to memory functioning in SLE, in spite of evidences of a progressive reduction of volume along SLE condition. For this reason, we aimed to explore further differences of critical memory-related brain structures volumes among SLE samples with and without episodic memory deficits and controls.

**METHOD AND MATERIALS**

Our sample was composed by $n=85$ individuals distributed in three groups: 1) SLE with episodic memory deficits (SLE+) ($n=17$); 2) SLE without episodic memory deficits (SLE-) ($n=34$); 3) controls without episodic memory deficits ($n=34$). Groups were matched on age, education, sex, MMSE, and SLICC. Episodic memory deficits were defined by performance on Rey Auditory Verbal Learning Test. All the participants were examined on a 1.5 Tesla MRI scanner. The protocol of image acquisition was: FLAIR sequence with axial and sagittal T1 3D MPRAGE. The FreeSurfer software was used to perform the cortical volumetric reconstruction and segmentation. One-way ANOVA and ANCOVA (time of diagnosis as a co-variate) analysis were performed in SPSS software.

**RESULTS**

Results indicated significant differences between SLE+>SLE- and SLE+>controls in the volume of the third ventricle. Co-variance analysis showed significant minor volume of right and left thalamus in SLE+ when compared to SLE-. No differences among groups were found in focused attention performance.

**CONCLUSION**

Our findings indicated group effects on right and left thalamus and on the third ventricle volumes. These findings are consistent with evidences of hippocampal-diencephalic interactions associated to episodic memory performance in SLE.

**CLINICAL RELEVANCE/APPLICATION**

Findings presented here suggest that thalamus may be the first episodic memory-related structure to be affected in the volumetric-anatomical level in SLE when the hippocampus is intact. An additional hypothesis would be that thalamus connections have a critical role in disrupting several neuropsychological processes in SLE.

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**SSG11-05 Right Arcuate Fasciculus Disruption in Chronic Fatigue Syndrome**


**PURPOSE**

(1) Detect microstructural abnormalities underlying chronic fatigue syndrome (CFS) using diffusion tensor imaging (DTI), (2) assess if gray and/or white matter volumes are abnormal utilizing T1-weighted volumetric analysis, and (3) detect suspected global alterations in brain perfusion using pseudo-continuous arterial spin labeling.
METHOD AND MATERIALS
15 CFS patients and 14 controls provided informed consent in accordance with Stanford’s Institutional Review Board and HIPAA. Subjects underwent 3.0T volumetric T1 and T2-weighted imaging, two DTI acquisitions, and ASL. Segmentations of supratentorial gray and white matter and cerebrospinal fluid were used to compare gray and white matter volume fractions and cortical thickness. DTI was processed with automated fiber quantification (AFQ), which compares piecewise fractional anisotropy (FA) along 20 tracks. The FreeSurfer segmentation was used to compare cerebral blood flow.

RESULTS
Bilateral white matter volume and right thalamic volumes were reduced in the CFS population. In CFS, FA was increased in the right arcuate fasciculus, and cortical thickness increased in both of its endpoints: the right middle temporal and right precentral gyri. In right-handers, FA was also increased in the right inferior longitudinal fasciculus, and thickness increased in one endpoint, the right occipital lobe. Within CFS patients, right anterior arcuate FA as well as basal ganglial volumes increased with disease severity. ASL showed no significant differences.

CONCLUSION
Bilateral white matter and right thalamic atrophy are present in CFS. Right hemispheric increased FA and cortical thickness are present, suggestive of a compensatory or pathological network. Right anterior arcuate FA may serve as a biomarker for CFS.

CLINICAL RELEVANCE/APPLICATION
Automated tractography can be useful for studying the microstructure underlying neurological disorders.
The low diagnostic yield associated with the usage of CT/MRI imaging in first episode psychosis (FEP) has caused a change in British guidelines to decrease redundant neuroimaging. However, imaging for FEP is still common in North America and remains a point of controversy. The purpose of this study is to assess current literature regarding the diagnostic value for FEP neuroimaging. This will help us determine the necessity of head CTs/MRIs in clinical practice for FEP patients.

METHOD AND MATERIALS

Electronic searches were performed in MEDLINE, PSYCHINFO and EMBASE in November 2013. Search criteria consisted of: "Psychotic Disorders", "Psychosis", "MRI", "CT", "Predictive Value of Tests", "Differential Diagnosis", "Biomedical Technological Assessment" and syntax derivatives of these search terms. After duplicates were removed, two reviewers screened 545 articles for inclusion. Studies included needed to meet the following: a) Patients must be presenting with FEP, b) Patients had a CT or MRI at the time of presentation, c) Studies must have reported abnormal or normal image results, and d) The rationale of the scan must be reported. Disputed articles between reviewers were resolved by a senior neuro-radiologist. All statistical analyses were performed using the Comprehensive Meta-Analysis Software. The event rate was computed as the number of patients with abnormal radiological findings possibly accountable for psychosis over the total number of patients that underwent imaging. Event rates for CT and MRI were summarized in separate forest plots, with the corresponding 95% confidence interval for each study.

RESULTS

Preliminary results from 8 abstracted studies show that, out of 1,019 CT/MRI scans, 838 scans were completely normal, whereas some abnormalities were observed in only 181 scans. Most abnormalities seen were either benign or incidental and did not have any impact on patient management. The calculated overall rate of abnormal findings that accounted for psychosis was 0.9% (95% CI: 0.5%-1.9%).

CONCLUSION

Given the low diagnostic yield of neuroimaging for FEP, more consideration needs to be given to ordering a head CT/MRI for FEP due to radiation and resource utilization concerns.

CLINICAL RELEVANCE/APPLICATION

Neuroimaging for FEP has very little value in determining the cause for psychosis and should be re-evaluated in psychiatric guidelines.

Investigating the Predictive Value of Whole-brain Structural Neuroimaging in Obsessive Compulsive Disorder: A Multivariate Pattern Classification Approach

Xinyu Hu (Presenter): Nothing to Disclose, Lizhou Chen: Nothing to Disclose, Yi Liao: Nothing to Disclose, Qi Liu: Nothing to Disclose, Fei Li MD: Nothing to Disclose, Yanchun Yang: Nothing to Disclose, Qiyong Gong: Nothing to Disclose, Xiaoqi Huang MD: Nothing to Disclose

PURPOSE

Obsessive-compulsive disorder (OCD) is one of the most common disabling psychiatric disorders. Many magnetic resonance imaging (MRI) studies have already revealed brain structural abnormalities in OCD patients involving both gray matter (GM) and white matter (WM). However, results of those publications were based on average differences between groups, which limited their usages in clinical practice. Multivariate pattern analysis (MVPA) approach is a promising analytical technique which allows the classification of individual observations into distinct groups. Therefore, the aim of this study was to examine whether the application of MVPA to high-dimensional structural MR images would allow accurate discrimination between OCD patients and healthy control subjects (HCS).

METHOD AND MATERIALS

High-resolution T1-weighted volumetric 3D MR images were acquired for 33 OCD patients and 33 demographically matched HCS using a 3.0 T MRI system. Structural images were preprocessed with the Diffeomorphic Anatomical Registration using the Exponentiated Lie algebra (DARTEL) toolbox. Differences in GM volume and WM volume between OCD and HCS were examined respectively using two sorts of well-established MVPA techniques, namely, Support Vector Machine (SVM) and Gaussian Process Classifier (GPC). We also drew a receiver operating characteristic (ROC) curve to help evaluate the performance of each classifier.

RESULTS

Results of SVM and GPC classification between OCD patients and HCS utilizing both GM and WM were shown in the figure. Overall, the classification accuracies for both classifiers regarding GM and WM anatomy were all above 75% and the highest classification accuracy (81.82%, P<0.001) was achieved with SVM classifier using WM information.

CONCLUSION

The current study illustrated that both GM and WM anatomical features might be used to classify OCD patients from HCS. WM volume with SVM approach showed the highest accuracy in current population to reveal group differences, which indicated its potential diagnostic role in helping detecting OCD.

CLINICAL RELEVANCE/APPLICATION

Using multivariate pattern analysis approach, we revealed structural MR images might be used to classify
obsessive compulsive disorder from controls and provided supports for its potential role as a diagnostic tool.

**SSG11-09**

**Abnormal Functional Connectivity of the Default Mode Network in First-episode, Drug-naïve Major Depressive Disorder: A Resting-state fMRI Study**

JING PENG MD (Presenter): Nothing to Disclose, Kuncheng Li MD: Nothing to Disclose, Peipeng Liang: Nothing to Disclose, Jiangtao Liu: Nothing to Disclose, Xin Ma: Nothing to Disclose, Gang Wang: Nothing to Disclose, Yang Li: Nothing to Disclose

**PURPOSE**

Dysconnectivity hypothesis posits that major depressive disorder (MDD) relates to abnormal resting-state connectivity within the default-mode network (DMN). Posterior cingulate cortex (PCC) is believed to have a key role in DMN and be involved in the pathophysiology of MDD. The goal of this study is to investigate whole-brain functional connectivity of PCC during resting state in subjects with MDD.

**METHOD AND MATERIALS**

A total of 17 patients with first-episode, drug-naïve MDD patients and 30 healthy well-matched volunteers were prospectively examined. Resting-state brain functional connectivity analysis was used to examine the correlation between the PCC and whole-brain regions.

**RESULTS**

Compared with healthy controls, MDD patients showed significantly decreased functional connectivity of the PCC in the left middle temporal gyrus and right superior frontal gyrus. Increased functional connectivity of the PCC was detected in the right insula, right transverse temporal gyrus, left precuneus, right lingual gyrus, left posterior cingulate, left superior/middle frontal gyrus, right cuneus, and right precuneus.

**CONCLUSION**

Our findings suggested that abnormal functional connectivity of the DMN exist in first-episode, drug-naïve MDD and further highlight the importance of the DMN in the pathophysiology of MDD.

**CLINICAL RELEVANCE/APPLICATION**

Resting-state fMRI can demonstrate functional connectivity of the default mode network in MDD and further highlight the importance of the DMN in the pathophysiology of MDD.

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**SSG12**

**Neuroradiology (Imaging of White Matter & Demyelinating Disease)**

*Scientific Papers*

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AMAPRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50

*Tue, Dec 2 10:30 AM - 12:00 PM  Location: N229*

**Participants**

Moderator
Aaron Scott Field MD, PhD: Research Consultant, BioTime, Inc

Moderator
Christopher David Lascola MD: Nothing to Disclose

**Sub-Events**

**SSG12-01**

**In Vivo Imaging of Myelin Using Ultrashort Echo Time (UTE) Sequences at 3T**

Vipul Ravindra Sheth MD, PhD (Presenter): Nothing to Disclose, Qun He MEng: Nothing to Disclose, Graeme M. Bydder MBChB: Nothing to Disclose, Jody Corey-Bloom: Nothing to Disclose, Jiang Du PhD: Nothing to Disclose

**PURPOSE**

Myelin is a lamellar membranous structure essential for proper function of the nervous system. In this study we aimed to image and quantify myelin in volunteers and patients with multiple sclerosis (MS) using ultrashort echo time (UTE) sequences on a clinical 3T scanner.

**METHOD AND MATERIALS**

The protons in myelin itself have very short T2s and are not detected with clinical sequences. We have
implemented a 2D adiabatic inversion recovery prepared dual echo UTE (IR-dUTE) acquisition with a TE of 8 μs to detect signals from these protons. An adiabatic inversion pulse was used to invert and null the long T2 components in white matter. The ultrashort T2 components are not inverted due to fast relaxation, and are detected by subsequent UTE data acquisition. Residual signals from other long T2 signals (e.g., gray matter) are suppressed via subtraction of the 2nd image from the first one, providing selective depiction of the ultrashort T2* components in white matter. The IR-dUTE sequence was applied to ten healthy volunteers and 12 MS patients using the following parameters: 24 cm FOV, 5 mm slice, 125 kHz bandwidth, 60°, 1500 ms TR, 420 ms TI, TE=8 μs and 2.2 ms, recon matrix=256X256, 6.5 min scan time. T2* was quantified with two interleaved 4-echo UTE acquisitions (TEs = 0.008/2.2/4.4/6.6 ms, 0.2/3.3/5.5/7.7 ms). T2* was quantified via mono-exponential fitting of the IR-UTE signal decay.

RESULTS

High contrast was achieved for myelin both in healthy volunteers and MS patients. Myelinated areas of white matter appeared high signal on IR-dUTE images and areas of presumed myelin loss appeared low signal. Myelin showed an ultrashort T2* of 0.2-0.5 ms. These results suggest that the IR-UTE sequence can generate high contrast images of myelin, and allow direct assessment of myelin loss and changes in its tissue properties via T2* measurement. Further validation will be performed via IR-UTE imaging of white matter specimens before and after D2O exchange (little or no change in IR-UTE signal would show that myelin is selectively directed).

CONCLUSION

The 2D IR-dUTE sequence can directly image and quantify the ultrashort T2* components in white matter of the brain in a clinical setting. There is significantly loss of the ultrashort T2* components, consistent with myelin loss in MS patients.

CLINICAL RELEVANCE/APPLICATION

Direct imaging and quantification of myelin may significantly advance the study of white matter diseases, including MS.

SSG12-02 Assessment of Surgical Damage to White Matter Fiber Tracts with Probabilistic Tractography in a Preclinical Porcine Model

Xiangyu Yang PhD (Presenter): Nothing to Disclose, Leo Ditzel MD : Nothing to Disclose, Lori Lynn Mattox : Nothing to Disclose, Daniel Prevedello MD : Nothing to Disclose, Michael Vinzenz Knopp MD, PhD : Nothing to Disclose

PURPOSE

To validate that postsurgical white matter (WM) fiber damage can be assessed with Diffusion Tensor Imaging (DTI) and probabilistic tractography in a porcine model.

METHOD AND MATERIALS

Two experienced neurosurgeons performed stereotactic brain surgical procedures simulating skull base surgery in human patient in nine adolescent female pigs. Pre- and postsurgical DTI data were acquired on a 3T MRI (Achieva, Philips Healthcare, Cleveland, OH) with a 32-channel cardiac coil using a high-angular resolution protocol with 240x240 mm FOV, 1.9x1.9x2 mm3 voxel, TR/TE/Flip Angle = 8100 ms/67 ms/90°, b = 0/1000 s/mm2, and 60 gradient directions. The DTI data were analyzed with the probabilistic tractography approach using FSL (FMRIB, Oxford, UK). Pre- and postsurgical data were registered with affine linear registration. Fractional anisotropy (FA), mean diffusivity (MD), radial (D_r) and axial diffusivity (D_a) were measured on 3x3x3 mm3 seed Region-Of-Interests (ROIs) placed in WM on surgical trajectory (4/animal) and on a reference fiber tract (2/animal) that connects primary and secondary visual cortex. Damage of WM fiber tracts from the surgical seed ROIs was quantified by the fraction of overlap between the pre- and postsurgical fiber volumes (OF = V_prenpost/V_pren). Linear mixed effect model was used for the statistical analysis.

RESULTS

The reference seeds have a mean OF value of 0.38 that reflects the inherent variability of the tractography technique and the registration error due to brain tissue loss, hemorrhage, and ventricular dilation. The surgical seeds have significantly lower OF (0.27, p=3e-8) than the reference seeds. No significant difference was found between pre- and postsurgical FA, MD, D_r or D_a values at the site of surgery, suggesting the difference in OF is related to direct mechanical damage to fibers in surgery, not secondary axonal damage or edema.

CONCLUSION

Surgical damage to WM fiber tracts can be effectively detected by DTI and probabilistic tractography within a few hours after brain surgery. Surgical damage to fiber is associated with low OF between pre- and postsurgical fiber volumes but not with any other diffusion parameter.

CLINICAL RELEVANCE/APPLICATION

DTI can be used as an objective quantitative tool for prospective evaluation of brain surgical techniques in animal model, and retrospective assessment of surgical outcome in human patient.
Dynamic Associations between Diffusion Indices and Their Underlying Pathology of Wallerian Degeneration in Central Nervous System

Min Zhang (Presenter): Nothing to Disclose, Kuncheng Li MD: Nothing to Disclose, Chunshui Yu: Nothing to Disclose, Wen Qin: Nothing to Disclose

PURPOSE

We aimed to address the exact relationships between the evolution of diffusion indices and its underlying pathology in central nervous system.

METHOD AND MATERIALS

Twenty-five domestic mature Felis catus were included in the present study. The evolution of diffusion indices, including mean diffusivity (MD), fractional anisotropy (FA), primary (λ1) and transverse (λ2,3) eigenvalues of the degenerated corticospinal tract, were observed at baseline (before modeling) and at 2, 4, 6, 8, 10, 15, 20, 25, 30, 45 and 60 days after modeling in 4 cats. Pathological examinations were performed at eight time points mentioned above.

RESULTS

Wallerian degeneration can be detected as early as the 2nd day after modeling by both diffusion tensor imaging and pathology. According to the evolution of diffusion indices, Wallerian degeneration can be classified into 2 stages. During the early stage (within 8 days after modeling), progressive disintegration of axons and myelin sheaths underlies the decreases in FA and λ1 and the increase in λ2,3. However, during the late stage (after 8 days), the gradual increase in FA, MD and λ1 and the unchanged λ2,3 seem to be a comprehensive reflection of the pathological processes including microglia activation, myelin clearance, and astrocytosis.

CONCLUSION

Our findings help the understanding of the altered diffusion indices in the context of pathology and suggest that diffusion tensor imaging has the potential to monitor the processes of Wallerian degeneration in the central nervous system in vivo after acute damage.

CLINICAL RELEVANCE/APPLICATION

DTI has the potential to monitor the processes of Wallerian degeneration in the central nervous system in vivo after acute damage.

Cardiovascular Risk Factors Predict the Spatial Distribution of White Matter Hyperintensity

Soham Banerjee BS (Presenter): Nothing to Disclose, Kevin S. King MD: Nothing to Disclose, Roderick McColl PhD: Nothing to Disclose, Anthony R. Whittemore MD: Nothing to Disclose, Keith Hulsey: Nothing to Disclose, Ronald M. Peshock MD: Nothing to Disclose

PURPOSE

To identify the spatial distribution of white matter hyperintensity (WMH) associated with hypertension, diabetes, hypercholesterolemia.

METHOD AND MATERIALS

MRI brain images were obtained from 2066 adult participants (858 males, 1208 females; mean age: 50) from a population based sample. An automated algorithm generated each participant's WMH distribution registered onto the MNI-152 standard template. For univariate analysis, each risk factor group was compared to the non-risk factor group. Voxels in which WMH frequency was significantly higher (p<0.05) in the risk factor group were mapped. Multivariate analysis consisted of subgroup analysis to minimize confounding of one risk factor on the others.

RESULTS

431891 MNI-space voxels comprised WMH distribution of the entire population. For univariate analysis, 26064 voxels (6%) of these voxels were exclusively associated with hypertension and were prevalent in the anterior frontal lobe. Similarly, 22527 voxels (5%) were exclusively associated with diabetes and were prevalent at the callosal septal interface. 8088 voxels (2%) were only associated with hypercholesterolemia and did not form a discrete spatial distribution. Multivariate results corroborated the univariate findings.

CONCLUSION

Each risk factor was associated with a unique spatial distribution of WMH. Hypertension was associated with WMH in the anterior frontal lobe and diabetes was associated with WMH in the callosal septal interface.

CLINICAL RELEVANCE/APPLICATION

Findings of WMH in the anterior frontal lobe of hypertensives and the callosal septal interface of diabetics should raise concern for end organ damage and consideration for aggressive medical therapy.
**SSG12-05**  
**Diffusion Tensor Imaging in Patients with Obstetric Antiphospholipid Syndrome without Neuropsychiatric Symptoms**  
Francesco Macri MD : Nothing to Disclose, Fabricio Pereira PhD, DSc : Nothing to Disclose, Jean-Christophe Gris MD, PhD : Nothing to Disclose, Jean-Paul Beregi MD : Nothing to Disclose, Marcel Parolin Jackowski PhD : Nothing to Disclose, Choukri Mekkaoui PhD (Presenter) : Nothing to Disclose

**PURPOSE**  
The impact of antiphospholipid antibodies (aPLAbs) on the brain of neurologically asymptomatic APS women with obstetric manifestations remains controversial [1]. Diffusion tensor imaging (DTI) was used to evaluate the structural integrity of white matter (WM) in women with non-thrombotic pregnancy loss and normal neuropsychiatric history, relative to the presence (APS+) / absence (APS-) of antiphospholipid antibodies (aPL). In addition, diffusion-based indices were compared to the presence/absence of lupus anticoagulant (LA) or aβ2GP1-G antibodies to characterize the level of microstructural alterations.

**METHOD AND MATERIALS**  
A total of 83 women with no record of neuropsychiatric symptoms (17 APS- and 66 APS+ women) were imaged using a 3T MRI scanner (GE Healthcare) with standard T1, FLAIR and TOF sequences and DTI (TR/TE=13000/88ms, 32 directions, b=1000s/mm², 3). Patients were tested for LA and/or aβ2GP1-G antibodies (37 APS- and 29 APS+ women). The fractional anisotropy (FA), mean diffusivity (MD) and radial diffusivity (RD) were calculated from DTI. Intergroup comparison of FA, MD and RD was carried out using Tract-Based Spatial Statistics. Regions with significant differences were identified by threshold-free cluster enhancement.

**RESULTS**  
No evidence of WM abnormalities was detected using T1, FLAIR and TOF. However, APS+ patients revealed a significant decrease in FA associated with an increase in MD and RD (p

**CONCLUSION**  
DTI revealed diffused microstructural WM changes in APS women with early non-thrombotic pregnancy loss, compatible with alterations in the axonal structure and myelin sheath. Compared to standard T1, FLAIR and TOF, DTI appears to be more sensitive to subtle WM abnormalities.

**REFERENCES**  

**CLINICAL RELEVANCE/APPLICATION**  
DTI-based indices combined with biological markers determine the level of microstructural WM integrity, leading to improved diagnosis and treatment of asymptomatic APS patients.

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**SSG12-06**  
**Whole Brain Functional Connectivity Changes in Patients with Multiple Sclerosis and Neuromyelitis Optica**  
Yaou Liu MD, PhD (Presenter): Nothing to Disclose, Yunyun Duan : Nothing to Disclose, Kuncheng Li MD : Nothing to Disclose

**PURPOSE**  
To compare the whole brain functional connectivity (FC) changes between patients with multiple sclerosis (MS) and neuromyelitis optica (NMO).

**METHOD AND MATERIALS**  
Resting-state fMRIs were collected from twenty-seven MS patients, 27 NMO patients and 27 age- and sex-matched healthy controls (HC) at a 3T MRI scanner. Whole brain functional connectivity (FC) in 90 brain regions was compared to investigate the difference among the three groups.

**RESULTS**  
109 functional connectivities were identified significantly different among the three groups. MS patients showed 20 altered functional connectivities compared with HC, while 12 with increased and 8 with decreased connectivities. The increased functional connectivities in MS mainly located in frontal lobe, while the decreased functional connectivities were between thalamus and cortical regions in temporary and occipital lobes. The NMO showed 44 significantly increased functional connectivities compared with HC and 65 increased functional connectivities compared with MS, mainly between deep grey matter such as amygdala, caudate, parahippocampus and widespread cortical regions.

**CONCLUSION**  
Different whole brain functional connectivity pattern were observed between the patients with MS and NMO. Functional damage and plasticity coexist in MS, while NMO patients show more widespread functional reorganization than MS patients.

**CLINICAL RELEVANCE/APPLICATION**  
This study revealed different whole brain functional connectivity pattern in MS and NMO. It helps understand the different pathophysiological basis of the two diseases.
SSG12-07  

**Multimodal Quantitative Magnetic Resonance Imaging of Thalamus in Multiple Sclerosis and Neuromyelitis Optica**

**Yaou Liu, MD, PhD (Presenter):** Nothing to Disclose  
**Yunyun Duan:** Nothing to Disclose  
**Jinhui Wang:** Nothing to Disclose  
**Kuncheng Li, MD:** Nothing to Disclose

**PURPOSE**

To compare the structural and functional alterations in thalamus between neuromyelitis optica (NMO) and multiple sclerosis (MS) by combining multimodal MRI techniques; and to investigate the correlations between different modalities and clinical variables.

**METHOD AND MATERIALS**

We studied the whole thalamus in 33 MS, 38 NMO patients and 40 well-matched healthy controls. Six measurements were obtained for the whole thalamus and seven thalamic subregions of each participant including the gray matter volume (GMV), fractional anisotropy (FA), mean diffusivity (MD), amplitude of low-frequency fluctuation (ALFF), cross-correlation coefficient of spontaneous low-frequency (COSLOF) and weighted functional connectivity strength (wFCS) from multimodality MRI data. All of the measurements were compared among groups using multiple one-way analyses of covariance (ANCOVA). Correlation between MRI-based measures and clinical variables was investigated by multiple partial correlation analyses. At last we performed a receiver operating characteristic curve analysis to determine the power of the observed between-group differences to classify the groups.

**RESULTS**

Significant group effects were detected in the GMV and WM integrity (FA and MD) of the whole thalamus (P < 10^{-3}), while only MS patients showed decreased COSLOF and wFCS than HC, no significant functional parameters were found between NMO and HC. Significant correlation was identified between structural measurements, but not between structural and functional measurement in both MS and NMO. The observed differences in structural GMV and FA/MD of the thalamus exhibited fair-to-good-excellent discriminative power indistinguishing the three groups (Figure 1).

**CONCLUSION**

Widespread alterations of thalamic structure and function were identified in patients with MS, while NMO showed milder structure damage without significant functional abnormalities. The thalamic structural parameters showed fair-to-good-excellent discriminative power with very high specificity in three groups, which serves as potential MRI biomarkers to distinguish MS, NMO and HC.

**CLINICAL RELEVANCE/APPLICATION**

This study revealed different patterns of thalamus involvement by multimodality MRI in MS and NMO. It helps understand the different pathophysiological basis of the two diseases and improve the differential diagnosis.

SSG12-08  

**Brain Intrinsic Resting-state Functional Connectivity Modulation Induced by Mental Effort in Multiple Sclerosis Patients with Fatigue**

**Emanuele Pravata, MD (Presenter):** Nothing to Disclose  
**Carlo Sestieri, PhD:** Nothing to Disclose  
**Massimo Caulo, MD, PhD:** Nothing to Disclose  
**Gianna Riccitelli, PhD:** Nothing to Disclose  
**Chiara Zecca MD:** Nothing to Disclose  
**Alessandro Cianfoni:** Nothing to Disclose  
**Claudio Gobbi, MD:** Nothing to Disclose

**PURPOSE**

To investigate changes of the resting-state functional connectivity (RS-FC) MRI induced by the execution of a cognitively effortful task in patients with relapsing-remitting multiple sclerosis (RRMS) with cognitive fatigue (CF).

**METHOD AND MATERIALS**

22 clinically stable RRMS patients, 11 with CF (F) and 11 without CF (nF) according to the Fatigue Scale for Motor and Cognitive Functions (FSCM) and 12 age- and gender-matched healthy control subjects (HS). RS-FC scans were acquired on a 3T MR scanner immediately before (t0), immediately after (t1) and 20 minutes after (t2) execution of the Paced Auditory Serial Addition Test (PASAT). Differences in the RS-FC strength between each brain voxel and the rest of the gray matter between F, nF and HS were investigated at each time point using a data-driven intrinsic connectivity contrast technique [Martuzzi et al, Neuroimage 2011] and 1-way between-subjects ANOVAs. The presence of a correlation between significant t2 and t2-t0 RS-FC differences and neuropsychological measures across patients was investigated. Structural and diffusion-tensor (20 gradient directions) data were acquired to evaluate atrophy, lesion load and white matter microstructure.

**RESULTS**

T2-hyperintense lesion load and brain atrophy did not differ between F and nF. Self-reported CF after PASAT (PASAT-F) was significantly higher in F than nF patients and HS (p=0.016, Mann-Whitney U test). Compared to nF and HS, F patients presented stronger RS-FC at t2 between the left dorsolateral prefrontal cortex (L-DLPFC) and pre-motor (Figure), secondary visual, left frontal and temporal areas (p=0.01, FDR-corrected). The RS-FC strength of these links at t2 and t0-t2 difference positively correlated with FSCM (r=0.65-0.73, p=0.001) and
PASAT-F (rho=0.4-0.59, p=0.044-0.02). Tractographic reconstructions of cortico-thalamic projection fibers, using L-DLPFC as a seed region, showed reduced fractional anisotropy in F compared to nF patients (0.39 vs. 0.43, p=0.047).

CONCLUSION

In RRMS patients, the degree of CF is related to persistence of hyperconnectivity within fronto-temporo-occipital networks despite relax after mental effort, and to disconnection of thalamo-cortical projection links.

CLINICAL RELEVANCE/APPLICATION

Identification of functional imaging biomarkers of CF, explaining RRMS patients' reduced resilience, may help clinical diagnosis and response assessment to specific medical and rehabilitative treatments.

SSG12-09

Assessment of Iron Deposition in the Brain in Multiple Sclerosis Using Ultrashort Echo Time (UTE) Sequences

Qun He MEng (Presenter): Nothing to Disclose, Vipul Ravindra Sheth MD, PhD: Nothing to Disclose, Wen Hong MS, MD: Nothing to Disclose, Lanqing Ma: Nothing to Disclose, Jody Corey-Bloom: Nothing to Disclose, Graeme M. Bydder MBChB: Nothing to Disclose, Jiang Du PhD: Nothing to Disclose

PURPOSE

Iron deposition may play a primary role in triggering inflammation and disease progression in multiple sclerosis (MS). However, iron overload may reduce T2 so much that clinical MR sequences may not be able to detect it. In this study we aimed to assess iron deposition in the brain of patients with MS using inversion recovery prepared ultrashort echo time (IR-UTE) sequences at 3T.

METHOD AND MATERIALS

We have implemented a 2D adiabatic inversion recovery prepared ultrashort echo time (IR-UTE) sequence (TE=8 μs) for high contrast imaging of iron deposition. An adiabatic inversion pulse was used to suppress the normal white matter and gray matter. Iron deposition tends to reduce T2* and T1, leading to high signal in regions with high iron concentration in IR-UTE imaging. We evaluated this technique on phantoms and patients with MS. The phantom contained 10 vials with different iron concentrations (0.5 to 60 mM). A TR of 750 ms and a TI of 250 ms were used for IR-UTE imaging of the iron phantom. Following the phantom study, 5 MS patients were recruited. They were studied with the following parameters: FOV=24 cm, slice thickness=5 mm, bandwidth=125 kHz, flip angle = 60°, TR = 1000 ms, TI = 330 ms, TE = 8 μs/2.2 ms, sampling points=191, projections=131, reconstruction matrix=256X256, scan time=4.4 min.

RESULTS

The phantom study shows that the conventional clinical IR-FSE sequence provides high contrast images of iron deposition in concentrations up to 2 mM, IR based gradient echo sequences, such as MP-RAGE can generate high contrast images of iron deposition in concentrations up to 5 mM, while the IR-UTE sequence provides high contrast images of iron deposition in concentrations up to 20 mM. The in vivo study shows that the IR-UTE sequence is capable of detecting iron deposition in MS patients. In the two MS patients shown in Figure 1, one patient shows near zero signal in the thalamus while the other shows high signal in the thalamus consistent with increased iron deposition.

CONCLUSION

The preliminary results show that the IR-UTE sequence can generate high contrast images of iron deposition in concentrations up to 20 mM in phantom studies. This sequence is also capable of high contrast imaging of iron deposition in the brain of patients with MS using a clinical 3T scanner.

CLINICAL RELEVANCE/APPLICATION

High contrast imaging of iron deposition may significantly advance the study of neuro-degenerative diseases including MS.
CONTINUATION

Gd-containing materials used in MRI imaging can serve as contrast agents for better delineation of target volumes. This study demonstrates that Gd can be used to enhance radiation dose in target volumes not only in HDR brachytherapy using Ir-192 source, but also in megavoltage external beam radiotherapy.

Background

As MRI is often used in tumor localization for radiotherapy treatment planning, gadolinium materials are often used to enhance the contrast. Motexafin gadolinium, an avid electron acceptor, is also a radiosensitizer, depleting the pool of the A repair substrates that become unavailable to repair the radiation-induced oxidative damage to DNA. It also increases intracellular oxygen levels, thereby potentially overcoming hypoxia and allowing “fixation” of radiation damage. This Monte Carlo study is the first quantitative investigation of Gd-induced dose enhancement in MV external beam therapy.

Evaluation

BEAMnrc, a radiotherapy Monte Carlo simulation package, was used to calculate dose enhancement as a function of Gd concentration. Published phase space files for the TrueBeam flattening filter free (FFF) and conventional flattened 6 MV photon beams were used. High dose rate (HDR) brachytherapy with Ir-192 source was also investigated. The percent mean dose enhancement for the FFF beam is 0.52±0.49, 1.34±0.40, 2.41±0.30, 3.71±0.38 and 4.67±0.41 for Gd concentrations of 1, 5, 10, 15, and 20 mg/mL respectively. The values for the flattened beams were 1.23±0.28, 1.90±0.32, and 2.54±0.24. For Ir-192, they are 0.70±0.39, 2.99±0.30, 5.68±0.23, 8.32±0.20 and 10.9±0.19.

Discussion

The mean energies for the 6 MV FFF and flattened beams are 0.9 and 1.3 MeV, respectively. The mean energy difference causes the dose enhancement difference between the two beams. Since the Ir-192 photons have lower yet energy, the photoelectric effect in the presence of Gd leads to even higher dose enhancement in HDR. The Gd concentration in MRI imaging or used as radiosensitizer is usually less than 5 mg/mL. Higher Gd concentration is preferred to have higher dose enhancement.

CONCLUSION

Nothing to Disclose
SSG13-05  One Shot Absorption Technique an Efficient Method to Evaluate the X-Ray Beam in a Quality Assurance Program

Maoz Benayun (Presenter): Nothing to Disclose

ABSTRACT

One Shot Absorption Technique
An Efficient Method to Evaluate the X-Ray Beam in a Quality Assurance Program

Maoz Ben Ayun, MSc, Dror Alezra, PhD, Alex Tsechanski, PhD

Introduction/Purpose:
Measurement of linear accelerator X-ray beam quality with an ion chamber in a water phantom is time consuming and may not detect small changes in the MV X-ray beam spectrum. We propose a new method to measure the quality of the X-ray beam using an Electronic Portal Imaging Device (EPID), a specially arranged set of lead absorbers and Eclipse portal dosimetry software.

Methods:
We constructed an absorber using 12 small lead foils ranging in thickness from 0.25mm to 3mm in increments of 0.25mm and a 0.5mm thick polystyrene plate. The foils were fixed to the plate in a circumferential pattern 72mm from the central axis of the beam. An EPID located 100cm from the source (SSD = 100cm) and 35cm from the polystyrene plate was used as the detector for the absorption measurements. The linear accelerator was used to deliver a single 100 monitor units (MU) irradiation through the 12 foil absorber and onto the EPID using a 12 x 28cm field. The single output was measured by the EPID. Portal dosimetry software on the Varian Eclipse treatment planning system was used to measure output in calibration units (CU) under each lead absorber from the single image. Beam quality was altered by placing full lead absorbers above the polystyrene plate or by adjusting the bending magnet current. Five different beam energies were studied (6MV, 6MV-FFF, 10MV, 10MV-FFF, 15MV) and compared with conventional methods for assessing beam quality.

Results:
Output decreases with increasing foil thickness in a linear relationship when CU measurements are plotted as a function of lead absorber thickness. Straight line fitting of the absorption curves of different X-ray beams results in substantially different slopes (tangent). Each measured X-ray beam was characterized by a specific slope. The slope of the absorption curve was sensitive to beam quality and small changes in beam quality caused small changes in slope. We predicted that increasing beam hardness would decrease the slope and decreasing beam hardness increase the slope. To test this hypothesis, we initiated variations in beam quality and found that change in slope was up to 50% more sensitive and better able to detect the predicted small variations in X-ray spectrum than ion chamber/water phantom measurements. The average time to collect a full set of measurements was substantially less than other methods.

Conclusion:
The one shot absorption method is reproducible, fast, efficient and easy to use in a clinical setting. It is more sensitive to small changes in X-ray beam quality than other methods which use an ion chamber and water phantom.

SSG13-06  A Focused Small Animal Irradiation Device Built on a Shepherd Cesium-137 Irradiator

Ahmad Al-Basheer PhD (Presenter): Nothing to Disclose

ABSTRACT

Purpose:
Focused radiation delivery to the tumor, part of the tumor, or other volumes of interest is often required in small animal radiation studies to isolate confounding factors from radiation to other areas, and to increase radiation dose to the target by sparing other organs. Studying the synergy between radiotherapy and immunotherapy is one example that requires such a focused radiation beam. However, such focused beam is not usually provided by many animal irradiators. The purpose of this study is to develop a device that delivers such a focused beam in a Shepherd Cesium-137 irradiator.

Methods:
We fabricated a Cerrobend based circular collimator placed behind a slit collimator to produce a focused radiation beam. The device also includes a platform to aid in animal immobilization. The slit collimator is provided by the vendor. The thickness of Cerrobend was 4 cm to ensure Results: The radiation dose for the focused beam was calibrated using the EBT2 film dosimetry and confirmed with the TLDs. Using AAPM task report 45, Flatness and Symmetry of the vertical and horizontal profiles for the circular beam were measured. For the vertical profile, Flatness was 7.7% and Symmetry was 7.0%, the penumbra (80, 20) width in the inferior direction was 1.41 cm, and in the superior direction was 1.76 cm. On the other hand, the horizontal profile had Flatness of 5.6%, Symmetry of 6.3%, left penumbra width of 1.41 mm, and right penumbra width of 1.41 mm. An interesting phenomenon we noted was a huge surface peak in the first a few millimeters when we measured the percent depth dose using a stack of EPT2 gafchromic films. This peak is approximate 2-fold higher than the relatively flat dose distribution in the depths > 2 mm. We speculate that this peak is due to the presence of contaminating secondary electrons. A 2-mm acrylic flat piece was used to block the secondary electrons in the animal experiments for uniform dose delivery to the target.

Conclusions: Cs137 irradiators can be used to deliver small field radiation using custom made collimators. Filled doses using these types of add-ons need to be measured and carefully evaluated. An acrylic piece or any other materials of equivalent thickness could be placed in front of the target to block potential secondary electron contamination. Gafchromic EBT2 films can provide a reliable way to measure percent depth dose and dose profile properties.

SSG13-07  Evaluation Of Dose Delivery Accuracy In Leaf Motion Calculator Algorithms For Sliding Window IMRT

Lili Wu MS (Presenter): Nothing to Disclose, Hong Chen BS: Nothing to Disclose, Jiayang Lu MS: Nothing to Disclose, Blake Rowedder PhD: Nothing to Disclose, Yuchen Kuang PhD: Nothing to Disclose

ABSTRACT

Purpose/Objective(s):
The dose delivery accuracy of IMRT is primarily dependent on how well the leaf motion pattern calculated by the leaf motion calculator (LMC) algorithm matches the optimized field fluence map obtained with MLC constraints. The Smart LMC (SLMC) in Eclipse treatment planning system is an advanced fluence delivery modeling algorithm as it takes into account fine MLC features including inter-leaf leakage, rounded leaf tips, non-uniform leaf thickness, and the spindle cavity etc. In this study, SLMC and traditional Varian leaf motion calculator (VLMC) algorithms were investigated, for the first time, in dose delivery accuracy of sliding window (SW) IMRT using three patient specific quality assurance (QA) tools.

Materials/Methods: The SW IMRT plans of 31 cancer cases (including 10 nasopharynges, 10 esophaguses, 9 breasts, 12 lungs, and 10 cervixes) were planned using the Varian Eclipse treatment planning system version 13.6. The SLMC and VLMC algorithms were investigated to evaluate their performance in dose delivery accuracy. The plans were delivered using a Varian 21EX linear accelerator with a 9f MLC. The delivery was verified using a Varian TrueBeam for daily QA and a MIM 3D VeriSoft for weekly QA. The QA tools included the EPID images, the portal images, and the surface dose measurements.

Results:
The results showed that the SLMC algorithm produced a more accurate dose distribution compared to the VLMC algorithm. The SLMC algorithm was able to better account for the fine MLC features, resulting in improved dose delivery accuracy. The SLMC algorithm had a higher conformity index and a lower integrated dose difference compared to the VLMC algorithm. This indicates that the SLMC algorithm is more capable of delivering the intended dose distribution as planned.

Conclusion:
The results of this study demonstrate the benefit of using the SLMC algorithm in SW IMRT plans. The SLMC algorithm has the potential to improve dose delivery accuracy and thus improve patient outcomes.
were included to evaluate dose delivery accuracy from leaf motion calculated by SLMC and VLMC. The leaf trajectories of each plan were derived from the same optimal fluence map by SLMC and VLMC, respectively. All plans were delivered using a Varian TrueBeam linear accelerator. Three-dimensional (3D) bi-planar diode array Delta4 and portal dosimetry from a high resolution 2D array electronic portal imaging device (EPID) were used to measure the delivered dose distribution. Independent dose calculation software IMSure was also used to verify the dose distribution. Gamma index was employed to compare the planned dose distribution calculated by both LMC algorithms and delivered dose distribution measured by three QA tools in all plans at 3%/3 mm, leading to a mean passing rate exceeding 97%. The IMSure calculation results show that the mean fraction of pixels with gamma < 1 was 97.0% ± 1.9% for SLMC and 98.9% ± 0.8% for VLMC. The Delta4 measurement results are in line with those of IMSure calculation. However, with the highest spatial resolution, EPID portal dosimetry demonstrates that gamma passing rate of SLMC was slightly higher than that of VLMC. The complex cases such as nasopharynx and cervical plans had the lowest gamma passing rate in the IMSure results, but showed a highest passing rate in portal dosimetry. Significant differences in the MUs were observed between these two LMCs (p < 0.001).

**Conclusions:** The study suggests that SLMC is modestly more accurate than VLMC in modeling advanced MLC features, which may lead to a more accurate dose delivery in SW IMRT. Current clinical tools might not be specific enough to differentiate the dosimetric discrepancies at the millimeter level calculated by these two LMC algorithms and complex cases.

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**SSG13-08**

A 4D Thermal Simulation Model and Validation for Percutaneous Microwave Ablation

Garron Deshazer MSc (Presenter): Nothing to Disclose, Scott Collins RT: Nothing to Disclose, Derek Merck: Nothing to Disclose, Damian E. Dupuy MD: Research Grant, NeuWave Medical Inc Board of Directors, BSD Medical Corporation Stockholder, BSD Medical Corporation Speaker, Educational Symposia

**CONCLUSION**

This initial model forms the basis of ongoing work in principled thermal simulation for ablation planning. Although promising margin predictions for ex-vivo procedures were made, further experiments need to be performed to test against uncertainty and variability. Future goals will be to test the model against other types of tissue ex-vivo, as well as incorporate tissue heterogeneity boundary conditions and heat sinks into the solution domain.

**Background**

Image-guided percutaneous ablation is an effective, inexpensive, and accessible treatment for many cancers. However, the relatively high recurrence rate in tumors over 3cm needs addressing. We hypothesize that the recurrence rate is due in part to poor margin control resulting from inaccurate, over-simplified treatment models in procedure planning. To address this shortcoming, we are developing a time-dependent thermal simulation model for percutaneous cancer ablation from first principles, and validating it against 4D experimental CT data.

**Discussion**

The 4D simulation data was overlaid onto the 4D ex vivo experimental data. Normalized Hounsfield unit changes revealed the ablated region of interest. The simulated 60, 80, 100 -degree isothermal contour mapping, that represents a 40, 60, and 80 degree change in temperature from prescriptive baseline (20 degrees, room temperature) track across all time points within less than 5mm of the observed cross-sectional ablation zone.

**Evaluation**

Our model uses finite element methods to solve Penn's Heat Equation and Maxwell's equations for electromagnetic energy transfer over time. Given electromagnetic, power dissipation, and heat boundary conditions for the solution domain, and inputs such as antenna composition and tissue properties, time-dependent physical partial differential solutions are found. The simulation for this experiment is based on a generic antenna inside homogeneous liver tissue with a generator setting of 60 watts for 15 minutes.

Validation 4D CT data sets were collected at 30-second increments during ablation procedures conducted on an ex vivo bovine liver.

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**SSG13-09**

Towards Patient-specific Biology-driven Heterogeneous Radiation Planning: Using a Computational Model of Tumor Growth to Identify Novel Radiation Sensitivity Signatures

Jacob G. Scott MD, MS: Nothing to Disclose, Russell Rockne BS, MS (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose/Objectives:** With the burgeoning evidence of a cancer stem cell architecture in a number of solid tumors, many of our assumptions about optimal dose and fractionation are being called into question. Further, it is well known that spatial heterogeneity in oxygen concentration can cause regions of relative radiation resistance. How these two forms of heterogeneity synergize, however, is not known. We use a theoretical model of a cancer stem cell-driven tumor to identify optimal therapeutic strategies for a range of cellular-oxygen distribution signatures, a novel metric we have developed, which we then utilize for planning of spatially heterogeneous dose maps to optimize tumor control for individual patients, in silico.

**Materials/Methods:** We have extended a previously developed computational model of a stem cell driven tumor to include host tissue interactions, oxygen uptake and heterogeneous vascularization. We simulate tumor growth on domains, which represent imaging voxels, under a variety of assumptions regarding vascular density/patterning and cell proliferation/differentiation. We correlate the distribution of cells (by type: stem vs. non-stem) versus the oxygen concentration that each cell experiences.

**Results:** By simulating tumors with a range of biological parameters, we have identified a family of cellular-oxygen distribution signatures, a novel metric we have developed, which we then utilize for planning of spatially heterogeneous dose maps to optimize tumor control for individual patients, in silico.

**Conclusions:** The ability to generate spatially resolved radiation sensitivity signatures for individual patients could usher in a new paradigm of imaging driven personalized radiotherapy. To achieve this, we have developed
a novel method by which to optimize radiation dose and fractionation for solid tumors given a theoretical measure of spatially resolved cellular-oxygen distribution and stem distribution. While our result is preliminary, the cell scale resolution of the model offers the possibility of translation of this method using information gleaned from MRI and PET (CD-133 and F-MISO) imaging.

**Impact of Patient Positioning on CT Image Quality: With and without Model Based Statistical Image Reconstruction Method**


**PURPOSE**

Inappropriate patient centering in CT imaging can lead to increase in image artifacts, noise level, and an elevation of radiation dose. The purpose of this work is to investigate whether the use of the model based statistical image reconstruction method equipped with a multi-slice CT scanner would alleviate the impact of patient mis-centering on CT image quality and radiation dose.

**METHOD AND MATERIALS**

A 64-slice clinical CT equipped with a MBSIR recon engine (Veo, GE Healthcare) was used to scan an anthropomorphic LUNGMAN phantom and a uniform polyethylene oval phantom using clinical scanning protocols. Custom-written software was used to perform online phantom centering from localizer radiographs. After centering and scanning, the mis-centered scans were produced by lowering the patient couch by 3 cm and 6 cm from the centered position and scanning with the same protocol. Both FBP and Veo reconstruction were performed on each scan. Quantitative image analyses were then performed using noise standard deviation (STD) and noise nonuniformity index (NNI) as metrics. A Monte-Carlo method was used to estimate dose delivered across each phantom.

**RESULTS**

For the chest phantom, there was no significant difference in the overall STD between the centered and the 3 cm mis-centered FBP images, but the 6 cm FBP image led to 14% increase in STD (p<2e-6) versus the centered FBP images. No significant difference in overall STD was found between the centered and off-centered Veo images (<0.3 HU). NNI increased from 13% (0 cm) to 43% (3 cm) or 68% (6 cm) in FBP images but remained constant in Veo images. For the oval phantom, the overall STD values were 7% and 25% higher (p<0.002) in the 3 and 6 cm off-centered FBP images, respectively, but no significant difference was found between the centered and off-centered Veo images (<0.4 HU). Mis-centering increased the overall dose by 1.5% (3 cm) or 4.5% (6 cm) in the chest phantom, and by 2.0% (3 cm) or 6.2% (6 cm) in the oval phantom.

**CONCLUSION**

Unlike the conventional CT images reconstructed by FBP, the noise magnitude and spatial uniformity of MBSIR images is insensitive to patient mis-positioning within 6 cm. However, significant mis-positioning could potentially limit the capability to reduce radiation dose to the patient.

**CLINICAL RELEVANCE/APPLICATION**

This work addresses a current concern about the importance of patient centering while using the increasingly popular MBSIR during routine CT exams.
PURPOSE

To investigate and to motivate the application of cadmium telluride (CdTe) detector technology for dedicated breast CT (BCT).

METHOD AND MATERIALS

We compared two detector technologies: a standard flat panel scintillation detector with 70 µm and 208 µm thick gadolinium oxyysulfide (GOS) scintillators and a photon-counting cadmium telluride (CdTe) detector with 1000 µm sensor thickness. The GOS detector had a pixel size of 75 µm, the CdTe detector a pixel size of 100 µm. In order to evaluate the detective quantum efficiency (DQE) the modulation transfer function (MTF) and the noise power spectrum (NPS) were determined initially. A tantalum phantom providing a 10 µm slit was used for both MTF simulations and MTF measurements. To improve the reliability of the NPS estimates, the noise characteristics of difference images were evaluated by using two independent flat image stacks. All measurements and simulations were performed at a tube voltage of 60 kV, suitable for clinical breast CT.

RESULTS

The simulations for GOS scintillator thicknesses of 70 µm and 208 µm delivered 10% MTF values of 6.5 lp/mm and 3.1 lp/mm, and DQE values of 18% and 45%, respectively. The CdTe detector went beyond this: the 10% MTF value was 9.5 lp/mm and DQE values of 98% were reached in the simulations. The measured MTF and DQE values were in good agreement with the simulations. Depending on the scintillator thickness, the GOS detector is either optimized for resolution (70 µm GOS) or efficiency (208 µm GOS). In contrast, the detector with 1000 µm CdTe offered both improved spatial resolution and significantly higher efficiency.

CONCLUSION

The photon-counting CdTe detector allows for significant dose reduction compared to the intensity-integrating GOS scintillation detector as shown by simulations and measurements. Our comparative evaluation of both technologies indicates that a potential dose saving of up to 80% may be possible by using CdTe detectors.

CLINICAL RELEVANCE/APPLICATION

The use of CdTe detector technology for BCT appears to be an important step to keep patient dose as low as reasonably achievable.
We expect that the transition of this method into clinical routine will lead to a much broader use of intraoperative 3D imaging in a wide field of clinical applications.

**SSG14-04**

**Automated Selection of the Optimal Cardiac Phase for Single-beat Coronary CT Angiography**


**PURPOSE**

The purpose of this study was to investigate an automated algorithm for selecting the optimal cardiac phase for CCTA reconstruction. Reconstructing a low-motion cardiac phase improves coronary artery visualization in coronary CT angiography (CCTA) exams.

**METHOD AND MATERIALS**

An automated algorithm was developed to select the optimal phase based on quantitative image quality (IQ) metrics. For each reconstructed slice at each reconstructed phase, an image quality metric was calculated based on measures of circularity and edge strength of through-plane vessels. The image quality metric was aggregated across slices, while a metric of vessel-location consistency was used to ignore slices that did not contain through-plane vessels. The algorithm performance was evaluated using two observer studies. Fourteen single-beat CCTA exams (Revolution CT, GE Healthcare) reconstructed at 2% intervals were evaluated for best systolic (1), diastolic (6), or systolic and diastolic phases (7) by three readers and the algorithm. Inter-reader (RR) and reader-algorithm (RA) agreement was calculated using the mean absolute difference (MAD) and concordance correlation coefficient (CCC). A reader-consensus best phase was determined and compared to the algorithm selected phase. In cases where the algorithm and consensus best phases differed by more than 2%, IQ was scored by three readers using a 5pt Likert scale.

**RESULTS**

There was no significant difference between RR and RA agreement for either MAD or CCC metrics (p>0.1). The algorithm phase was within 2% of the consensus phase in 76% of cases. There was no significant difference (p=0.1) between the IQ of the algorithm phase (4.06±0.73) and the consensus phase (4.11±0.76).

**CONCLUSION**

The proposed algorithm was statistically equivalent to a reader in selecting an optimal cardiac phase for CCTA exams. When reader and algorithm phases differed by >2%, IQ was statistically equivalent.

**CLINICAL RELEVANCE/APPLICATION**

By detecting the optimal phase for CCTA reconstruction, the proposed algorithm can improve coronary artery visualization in CCTA exams.

**SSG14-05**

**Automated Segmentation of Chest and Abdominal Organs for Image Quality Assessment in Pediatric CT**

Carlos A. Parra PhD: Nothing to Disclose, Samuel L. Brady MS, PhD (Presenter): Nothing to Disclose, Robert A. Kaufman MD: Nothing to Disclose

**PURPOSE**

CT image quality is typically estimated using a variety of well-established system level descriptors. As part of an ongoing study to quantify these quality descriptors, the proposed neural network-based segmentation method was used to identify a set of anatomical structures from clinical CT imaging for a variety of patient sizes and body compositions. Future studies will rely on these results to establish an image quality methodology based on anatomical structures.

**METHOD AND MATERIALS**

Contrast in CT imaging data was enhanced via histogram equalization, before applying 3-D filters used to derive frequency and intensity information; selected filters included morphological filters (open, close, dilate, erode), FFT band-pass filters, and Hessian filters. A linear vector quantization (LVQ) neural network was used to classify each voxel. For network training, labels from a set of anatomical structures and tissues (liver, spleen, kidney, lung, blood, bone, muscle, adipose) were assigned to coordinates manually selected from each structure. Tissue classification was based on a vector of local features (mean, standard deviation, maximum, minimum voxel intensity) computed from a seed growing vicinity around each voxel from each tissue volume. Code was written in MATLAB using Image Processing and Neural Networks toolboxes. (The MathWorks, Inc., Natick, MA, USA).

**RESULTS**

Successful segmentation was attained within a three-dimensional volume for liver, spleen, kidney, lung, blood, bone, muscle, and adipose tissue using different combinations of image features. Due to voxel size anisotropy, segmentation is optimized when the size of the local feature seed growing vicinity (in mm) closely resembles a cubic region. The segmentation code functions across a range of body sizes from thin to obese pediatric patients, and for a variety of patient image contrast levels (i.e., for contrast and non-contrast studies).
CONCLUSION

The segmentation code accurately identifies and segments thoracic and abdominal organs, providing the potential to segment different combinations of internal organs for patient-level automated in-vivo quantitative image quality analysis system.

CLINICAL RELEVANCE/APPLICATION

Accurate anatomical segmentation of CT will be used for automated patient image quality analysis and further dose reduction investigations. Such analysis can also be extrapolated to adult CT imaging.

SSG14-06
Comparison of Image Noise and Quality between Dual-source, Full Dose Abdominal CT Scans Reconstructed with Filtered Back Projection and Half Dose Scans Reconstructed with Third Generation Modeled Iterative Reconstruction Algorithm (SAFIRE+)

Stephen Choy MD (Presenter): Nothing to Disclose, Dennis Parhar BSc: Nothing to Disclose, Kevin Lian MD: Nothing to Disclose, Luck Jan-Luck Louis MD: Nothing to Disclose, Tim O’Connell MD: Meng: President, Resolve Radiologic Ltd, Katharine Grant PhD: Employee, Siemens AG, Patrick McLaughlin FFR(RCSI): Nothing to Disclose, Savvas Nicolaou MD: Nothing to Disclose

PURPOSE

We conducted a retrospective intra-individual study to compare the image noise, signal-to-noise ratio (SNR) and subjective image quality between CT images acquired with a dual source, split dose imaging protocol reconstructed at full and half dose with filtered back projection (FBP) and a novel third generation modeled iterative reconstruction algorithm (SAFIRE+).

METHOD AND MATERIALS

53 consecutive patients underwent contrast enhanced CT abdomen using a standardized dual source, single energy CT protocol (100kV, ref mAs 162, 32x0.6 mm) on a 128-slice CT scanner (Definition FLASH, Siemens Healthcare, Germany). Half dose images using projection data only from detector A were retrospectively generated from scanner raw data. The full dose dataset was reconstructed with FBP, while the half dose dataset was reconstructed with FBP and SAFIRE+ from strengths 1 to 5. Region of interest analysis was performed on four structures within the abdomen and assessed for noise and SNR. Qualitative interpretation was performed by a radiologist with 8 years of experience. Diagnostic acceptability, subjective noise and spatial resolution were graded on a 10 point scale. Statistical analysis was done with repeated measures analysis of variance and Wilcoxon signed rank test.

RESULTS

There was a statistically significant decrease in objective noise and increase in SNR for 50% dose SAFIRE+ strength 4 and 5 compared to 100% dose FBP (p<0.01). No statistically significant difference in noise and SNR was measured for SAFIRE+ strength 3 compared to 100% dose FBP. With increasing strength of SAFIRE+, there was a progressive increase in diagnostic acceptability, decrease in subjective noise and increase in spatial resolution for 50% dose images reconstructed with increasing strengths of SAFIRE+ (p<0.01).

CONCLUSION

Half dose CT images reconstructed with SAFIRE+ at a strength of 3 are equivalent with full dose images reconstructed with FBP. Unlike previous generations of hybrid iterative reconstruction, increased image quality scores were demonstrated at higher SAFIRE+ strengths, potentially allowing dose reductions on the order of 50%.

CLINICAL RELEVANCE/APPLICATION

A novel third generation modeled iterative reconstruction algorithm (SAFIRE+) may allow for a 50% dose reduction in abdominal CT acquisition protocols while maintaining image quality and image noise.

SSG14-07
The Correct Selection of Pitch and Rotation Time for Optimal CT Scanning – “The Big Misconception”; The Effects of Pitch on Image Quality and Patient Dose in Both Manual mA and AEC - mA Modulation Scanning Modes

Frank N. Ranallo PhD (Presenter): Grant, General Electric Company, Timothy Peter Szczykutowicz PhD: Equipment support, General Electric Company Research Grant, Siemens AG

CONCLUSION

The proper selection of the pitch and rotation time not only affects the total scan time but also the image quality and dose in ways that are commonly misunderstood. A proper understanding of the effect of changing the pitch and rotation time in can provide improve image quality and/or reduced patient dose.

Background

Presently in CT scanning there is an essential need to provide correct guidance in the proper selection of pitch and rotation time for optimal CT imaging. There exists a widespread misconception concerning the role of pitch.
in patient dose with modern multi-slice scanners, particularly with the use of mA modulation techniques. We investigated the relationship of pitch and rotation time to image quality, dose, and scan duration, with CT scanners from different manufacturers in a way that clarifies this misconception. This source of this misconception may concern the original role of pitch with single slice CT scanners.

**Evaluation**

As expected we found that the dose is generally independent of the selected effective mAs (mA*time/pitch) with manual mA technique settings; the image noise is often, but not always independent of the selected effective mAs. The dose and image noise are often independent of the selected pitch and/or rotation time with automatic mA modulation techniques. However we did find that on certain scanners the use of a pitch just above 0.5 provided images of equal image noise at a lower dose compared to the use of a pitch just below 1.0.

**Discussion**

The misconception that the use of a lower pitch over-irradiates patients by wasting dose is clearly false. The use of a lower pitch provides images of equal or better image quality at the same patient dose, whether using manual mA or automatic mA modulation techniques. By decreasing the pitch and the rotation times by equal amounts, both helical and patient motion artifacts can be reduced without affecting the exam time. The use of lower helical pitch also allows better scanning of larger patients by allowing a greater scan effective mAs, if the exam time can be extended. The one caution with the use of low pitch is not related to patient dose, but to the length of the scan time if the rotation time is not set short enough.

**SSG14-08 Putting Numbers to Images: Comprehensive Quantitative Image Quality Assessment for Computed Tomography Using Semi-automatic Analysis Software**

**Gregor Pahn DIPLPHYS (Presenter): Nothing to Disclose , Stephan Skornitzke: Nothing to Disclose , Jens Hansen DIPLPHYS: Nothing to Disclose , Hans-Ulrich Kauczor MD: Research Grant, Boehringer Ingelheim GmbH Research Grant, Siemens AG Research Grant, Bayer AG Speakers Bureau, Boehringer Ingelheim GmbH Speakers Bureau, Siemens AG Speakers Bureau, Novartis AG, Wolfram Stiller PhD, DIPLPHYS: Nothing to Disclose**

**PURPOSE**

Clinical applications of computed tomography (CT) show a trend towards quantitative imaging, offering objective information to aid clinicians in their decisions. In order to guarantee reliable and reproducible results, demands on accuracy and stability of imaging systems are more rigorous than ever, making standardized procedures for quality assurance (QA) imperative. In this study, a novel analysis tool for semi-automatic standardized quantitative evaluation of CT image quality (IQ) is presented and assessed based on a standardized set of phantom measurements.

**METHOD AND MATERIALS**

Using DICOM CT image data, the IQ software developed in-house allows for analysis of CT number accuracy, noise magnitude and power spectrum (NPS), uniformity across the field-of-view, contrast-to-noise ratio (CNR), and spatial resolution (SR) from bar patterns and edges. Maximum information is used by automatically including all slices, enabling quantitation and correction of phantom alignment inaccuracies. The object-oriented software implemented in C++ features a modular, extendable design for maximum automation of IQ assessment and offers a graphical user interface (GUI). Image data of two commercially available phantoms acquired with various protocols on a CT system before and after a detector upgrade is used for evaluating the software's capabilities.

**RESULTS**

The software runs stable independent of CT data source. Customizable regions-of-interest (ROI) are automatically placed and propagated throughout all image slices of each IQ phantom section. CT number and noise distributions are automatically filled to 2D and 3D histograms; mean values as well as resp. standard deviations are calculated and also used for CNR evaluation. The results can be fitted algorithmically. Pixel-by-pixel analysis of ROIs yields NPS for noise frequency and edge-spread and modulation-transfer functions for SR assessment. The software allows for comprehensive graphical presentation and data export of all results.

**CONCLUSION**

The CT IQ analysis software enables standardized and highly automated IQ assessment. Results are reproducible and reliable due to high statistics. Additional phantom types and evaluation algorithms can easily be implemented.

**CLINICAL RELEVANCE/APPLICATION**

The novel CT IQ analysis software enables time-effective standardized automated QA and assurance of IQ equivalence for different scanner models and acquisition protocols, e.g. for multicenter studies.

**SSG14-09 Experimental Assessment of Z- and Axial Spatial Resolution of Statistical Model Based Iterative Reconstruction and Its Correlation with Image Noise**

**Ke Li PhD (Presenter): Nothing to Disclose , John W. Garrett MS: Nothing to Disclose , Yongshuai Ge :**
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**

The purpose of this study was to assess the task- and dose-dependence of the spatial resolution of statistical model based iterative reconstruction (MBIR) along both axial and z directions and to examine the impact of spatial resolution on the model observer performance.

**METHOD AND MATERIALS**

The thoracic section of an anthropomorphic phantom was scanned using a 64-slice clinical CT system (CT750 HD, GE Healthcare) at four dose levels ($\text{CTDI}_{\text{vol}}=4, 8, 12, 16 \text{ mGy}$). Both FBP and MBIR (Veo, GE Healthcare) were used for image reconstruction. Nine objects embedded in the phantom with contrast values ranging from 13 to 1710 HU were used to assess spatial resolution. The axial and z resolutions were quantified locally in the image domain by point spread functions (PSF) and slice sensitivity profiles (SSP) respectively. All the scans were repeated by 100 times and averaged, which enabled spatial resolution of ultra-low contrast objects to be accurately measured. The repeated scans also enabled assessment of local noise standard deviation and the detectabilities index ($d'$) of a channelized Hotelling (CHO) model observer.

**RESULTS**

The axial resolution of MBIR improved monotonically with increasing dose and contrast level ($\text{FWHM}_{\text{PSF}}=2.0 \text{ mm at 13 HU/25% dose and was 0.8 mm at 1710 HU/100% dose}$). In comparison, axial resolution of FBP is independent of dose and contrast ($\text{FWHM}_{\text{PSF}}=1.2 \text{ mm}$). The z resolution of MBIR demonstrated similar contrast dependence but only negligible dose dependence. The spatial resolution of MBIR and FBP became equivalent at some transitional contrast levels (280 HU for 25% dose and 90 HU for 100% dose), above which MBIR demonstrated superior resolution than FBP (and vice versa). Spatial resolution and noise assessed at the same location demonstrated a strong tradeoff in MBIR, and CHO detectability index $d'$ was improved by [48%, 115%] with MBIR depending on the contrast and dose level.

**CONCLUSION**

MBIR produces images with unique spatial resolution characteristics and introduces new challenges to its clinical use and evaluation. One potential solution, as suggested by this work, is to perform rigorous spatial resolution and noise measurements at different dose levels for each specific task.

**CLINICAL RELEVANCE/APPLICATION**

The results provide new guidance for the optimal prescription of scanning parameters when a MBIR method is used in clinical routine CT exams for dose reduction and/or diagnostic performance improvement.

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**SSG15**

**Physics (Radiation Doses I: Measurements, Issues in CT)**

**Scientific Papers**

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

Tue, Dec 2 10:30 AM - 12:00 PM | Location: S404AB

**Participants**

Moderator
Michael F. McNitt-Gray PhD: Institutional research agreement, Siemens AG Research support, Siemens AG

Moderator
Dianna D. Cody PhD: In-kind support, General Electric Company

**Sub-Events**

**SSG15-01**

Patient-diameter Specific Local and National DRLs for Adult Body CT

Sean Cournane MSc, PhD (Presenter): Nothing to Disclose, Dara Murphy: Nothing to Disclose, Michael Rowan BSc,MSc: Nothing to Disclose, Una O’Connor: Nothing to Disclose, David P. Costello MSc, BSc: Nothing to Disclose, Niall Sheehy MBBS: Nothing to Disclose, Neil O’Hare: Nothing to Disclose

**CONCLUSION**

This study presents the establishment of appropriate adult diameter-based local and national DRLs for the entire adult population.

**Background**

Diagnostic Reference Levels (DRLs) provide an investigative level to identify unusually high patient doses. CT adult DRLs are currently calculated as the 75th percentile of exam specific CTDIvol and DLP datasets for adult patient samples of weight range 60-80kg and typically based on small samples of 10 or more. While DRLs provide a practical metric for 'normal' adult patients, these investigative levels if used for the broad size range of all patients may prove inappropriate. Further, it is well known that body weight is poorly correlated with CT dose metrics, prompting the question as to whether DRLs in their current form are fit for representing the entire adult population. Size-specific reference doses have been suggested for paediatric patients; however, such analyses have not been performed in adults. Accordingly, the object of this work was to propose...
diameter-based local and national DRLs and to examine the variability of diameter-specific metrics across examinations and hospitals sites.

**Evaluation**

Dose metric data from 19 CT scanners across the Irish National Integrated Medical Imaging System (NIMIS), for all examinations (n=149784), was captured by Radimetrics exposureTM software over an 18-month period, allowing for the collation of CT scanning parameters including CTDIvol, DLP, Size-Specific Dose Estimate (SSDE) and effective patient diameter. After data cleansing, diameter-specific 25th, 50th and 75th parameter percentiles were calculated to inform on establishing local and national DRLs with high volume, high dose and newly established CT exams investigated.

**Discussion**

For patients of increased diameter, elevated 75th percentiles were evident when compared with normal-sized patient levels, suggesting traditional DRLs to be ineffective at flagging higher dose investigative levels for all patients. The work also allowed for the comparison of examination- and size-based CT dose metrics for systems of similar model and manufacturer, in addition to across a range of manufacturers.

**Effective Dose of Chest X-ray, Tomosynthesis, and Thoracic CT in a Multi-Center Clinical Trial**


**PURPOSE**

Digital tomosynthesis (DTS) imaging is increasingly being used for numerous thoracic indications. In addition to evaluation of the diagnostic capability of this technique, it is important to understand the dose to the patient relative to conventional chest x-ray (CXR) and CT protocols.

**METHOD AND MATERIALS**

An international, multi-center, clinical trial was designed and conducted under IRB approval to compare the performance of DTS to conventional two-view CXR for the detection of lung nodules, using CT as the reference standard. Subjects in the study had a diagnostic CT exam as part of routine care for a variety of thoracic indications, and then received conventional 2-view CXR and DTS exams (GE Healthcare, XR656 with VolumeRAD). Effective dose for CXR and DTS was calculated using the PCXMC Monte Carlo tool (STUK, Finland). Calculation of absorbed dose was based on estimates of incident air kerma from exposure technique data and the assumption of average habitus subjects. CT effective dose was calculated using the ICRP 103 methodology from the DLP determined from reported CTDI values.

**RESULTS**

Technique data for dose estimation was available for all 158 subjects in the study for some modalities, and for 91 subjects for all modalities. For the 91 cases with valid data for all modalities, the mean effective dose (and standard deviation) was 0.059 (0.033), 0.088 (0.037), and 4.86 (3.2) mSv for CXR, DTS, and CT respectively. The use of 0.2 mm Cu additional filtration (at 120 kVp) was observed to reduce the effective dose for the DTS subjects. The variation in DTS effective dose was much less than CXR as a result of increased uniformity of delivered mAs per projection in the DTS acquisition.

**CONCLUSION**

For the patients in this clinical trial, the average effective dose of a DTS acquisition was only 1.5 times greater than that of a conventional two-view chest radiograph, and significantly less than that of the diagnostic thoracic CT exams. DTS provides tomographic image information, enabling significantly increased nodule detection sensitivity, with less than 0.1 mSv effective dose.

**CLINICAL RELEVANCE/APPLICATION**

Digital tomosynthesis imaging provides volumetric image data enabling increased lung nodule detection compared to conventional chest x-ray at a similar, minimal, radiation level (less than 0.1 mSv).

**Multi-phase CT: Impact of Contrast Medium Propagation on Radiation Dose across a Population of Patient Models**

Pooyan Sahbaee (Presenter): Nothing to Disclose, William Paul Segars PhD : Nothing to Disclose, Ehsan Samei PhD : Research Grant, Siemens AG Research Grant, General Electric Company Research Grant, Carestream Health, Inc

**PURPOSE**

To quantify the radiation dose variation as a function of time due to the contrast medium (CM) administration in multiphase liver CT scan across a library of 5D XCAT models.

**METHOD AND MATERIALS**

The dose estimation was performed on a library of 58 adult extended cardiac-torso (XCAT) models. To generate the 5D XCAT patient models, a unique method was developed to incorporate the dynamics of CM propagation.
into our 4D XCAT (as demonstrated in our prior work, the fourth dimension reflects the heart and respiratory motions) anthropomorphic models. The models were created based on patient-specific iodine concentration-time results from our computational CM propagation computer model for different injection protocols, such that each organ in a patient model subjected to a specific injection protocol was assigned to its own unique CM time-concentration curve. The radiation dose to individual organs in the models was estimated from a four-phase (pre-contrast, arterial, portal venous, and delayed phases) liver CT examination modeled via a validated Monte Carlo simulation software package (PENELOPE). For each scan time point after the injection, 80 million photons were initiated and tracked through the phantoms. Finally, the dose to the liver was tallied from the deposited energy.

RESULTS
The liver CT scan simulation results from 5D XCAT models subjected to a commonly used injection protocol (120 mL of 350 mgI/mL CM at 4 mL/s) indicated up to 10%, 32%, and 24% increases in radiation dose delivered to the liver for arterial phase (to 9.45 mGy), portal venous phase (to 11.29 mGy), and delayed phase (to 10.65 mGy), respectively.

CONCLUSION
Administration of contrast medium in enhanced CT scan not only remarkably affects the CT image quality (thus the reason for its use), but also notably increases the radiation dose. Particularly, multiple acquisitions in several enhanced CT protocols accentuate the radiation dose as a critical objective in optimization of the protocols.

CLINICAL RELEVANCE/APPLICATION
The study aimed to provide a methodology to incorporate the contrast medium propagation in XCAT models, thus building toward an opportunity to optimize radiation dose and injection protocol in concert.

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SSG15-04
Dose to Organs and Tissues from Scattered Radiation in Breast CT: Impact on Effective Dose
Sabrina Viviane Vollmar PhD : Nothing to Disclose , Daniel Kolditz PhD (Presenter): Employee, CT Imaging GmbH , Martin Hupfer PhD : Employee, CT Imaging GmbH , Willi A. Kalender PhD : Consultant, Siemens AG Consultant, Bayer AG Founder, CT Imaging GmbH Scientific Advisor, CT Imaging GmbH CEO, CT Imaging GmbH

PURPOSE
To evaluate potential dose contributions by scattered radiation to organs and tissues not directly exposed and the resulting effective dose in dedicated breast CT.

METHOD AND MATERIALS
Calculation of dose in the directly and not directly exposed parts of the body were performed for dedicated breast CT at tube voltages of 40, 60 and 80 kV with a Monte Carlo (MC) software tool (ImpactMC, CT Imaging GmbH, Erlangen, Germany). Effective dose was calculated according to the ICRP publication 103. We used the standard female ORNL (Oak Ridge National Laboratory) phantom to mimic the patient lying prone on the examination table and added cylindrical phantoms with 10 and 14 cm diameter, and 7.5 and 10.5 cm in length, respectively to mimic the pendant breast. Only the examined breast was directly exposed. The air kerma of the scans was adapted to achieve an average glandular dose (AGD) of 1.6 and 4.6 mGy, respectively, for the two breast sizes, which corresponds to the dose limits in mammography.

RESULTS
Effective dose was confirmed at 0.192 mSv and 0.552 mSv for 10 and 14 cm breast sizes, respectively, for all tube voltages without scattered radiation. When taking scattered radiation into account effective dose increased to 0.200 and 0.601 mSv, respectively, for 60 kV. These values were reduced to 0.197 and 0.591 mSv when adding an absorption foil (150 µm Pb) to the examination table. Respective values were 0.196 and 0.570 mGy for 40 kV and 0.202 and 0.608 mGy for 80 kV. For the not directly exposed tissues highest organ dose values were found in the lung amounting to 0.029 and, 0.146 mGy, respectively. Adding the absorption layer to the table reduced these values to 0.026 and 0.128 mGy, respectively.

CONCLUSION
Effective dose in dedicated breast CT for a bilateral examination with typical values of 0.2 to 0.6 mSv is low; scattered radiation only contributes 2-3%, 3-7% and, 5-9% additional dose to these values for 40, 60 and 80 kV, respectively.

CLINICAL RELEVANCE/APPLICATION
Dedicated breast CT potentially offers higher sensitivity and specificity for breast cancer detection without increasing dose levels significantly.

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SSG15-05
Quantifying the Effects of Patient Size, Scanner Selection and Scan Start Location on Organ Dose Estimates in Contiguous Axial Head CT Examinations
SSG15-06

Modern CT Pulmonary Angiography or Lung Perfusion Scintigraphy in Pregnant Patients Suspected for Pulmonary Embolism? Comparison of Associated Radiation Risks

Konstantinos Perisinakis PhD (Presenter): Nothing to Disclose, Ioannis Seimenis PhD: Nothing to Disclose, Antonis Tzedakis MS: Nothing to Disclose, John Emmanuel Damilakis MD: Nothing to Disclose

PURPOSE

To provide and compare maternal and fetal radiation dose burden and associated radiation cancer risk estimates from 256-slice CT pulmonary angiography (CTPA) and lung perfusion scintigraphy (LPS).

METHOD AND MATERIALS

The BodyBuilder software package was employed to generate mathematical anthropomorphic phantoms representing the average female individual at early pregnancy and at 1st, 2nd and 3rd trimester of gestation. In each phantom, 1-3 additional 1.5 cm-thick fat tissue layers were added to produce phantoms of different body size. Monte Carlo methods were used to simulate low-dose 256-slice CTPA exposures on each of the 16 generated phantoms. Normalized maternal organ and conceptus dose data were derived for exposures at 80, 100 and 120 kV. Maternal and conceptus doses from 256-slice CTPA were determined and compared to corresponding estimates for low-dose LPS. Total life attributable risks (LARs) of cancer associated with 256-slice CTPA and LPS were determined using previously published radiation cancer risk factors and compared to intrinsic risk of cancer for 20-, 30- and 40-years old female individuals.

RESULTS

For an average-size pregnant patient, the low-dose 256-slice CTPA exposure was found to result in a maternal effective dose of 1 mSv and a conceptus dose of <0.06 mGy. However, maternal effective dose was found to considerably increase with body size, while conceptus dose was increased with both body size and gestational stage. Compared to LPS, low-dose CTPA to an average-sized pregnant patient was found to result in 15% higher maternal effective dose, but 3.4-6 times lower conceptus dose. Nevertheless, LPS was found to be associated with less aggregated radiation risk for an average size pregnant patient with the difference from CTPA to be further increased for larger patients. Low-dose 256-slice CTPA at the age of 20, 30 and 40 years marginally increases the intrinsic risk of cancer by 1.0007, 1.0004 and 1.0003, respectively.

CONCLUSION

LPS remains more dose efficient even compared to low-dose CTPA performed with a modern wide-area CT scanner.

CLINICAL RELEVANCE/APPLICATION

LPS should be maintained as the preferable next step of imaging for pregnant patients suspected for pulmonary embolism who have a normal chest X-ray radiograph and require further investigation.
SSG15-07  
Radiation Dose and Image Quality Performance of Organ-based Tube Current Modulation for Head and Chest CT Scans


PURPOSE

The purpose of this study was to quantify dose and noise performance of organ-dose-based tube current modulation (ODM) through experimental studies with an anthropomorphic phantom and simulations with a phantom library.

METHOD AND MATERIALS

ODM reduces tube current for anterior source positions, without increasing current for posterior positions. Axial CT scans at 120 kV were performed on head and chest phantoms (Rando Alderson Research Laboratories, Stanford, CA) on an ODM-equipped scanner (Optima CT660, GE Healthcare, Chalfont St Giles, England). Dosimeters quantified dose to breast, lung, heart, spine, eye lens and brain regions (mobile MOSFET Dosimetry System, Best Medical, Ottawa, Canada) for ODM, automA (z modulation), and smartmA (angular and z modulation) settings. Noise standard deviation was calculated in brain and chest regions of reconstructed images. To study a variety of patient sizes, Monte Carlo simulations, validated with experimental data, were performed on 28 voxelized head phantoms and 10 chest phantoms. Organ dose and reconstructed noise standard deviation were compared for all phantoms. Image quality assessment is currently underway using a task-dependent signal detectability metric.

RESULTS

ODM reduced dose at all dosimeters with respect to smartmA, with dose changes of -31.3% (breast), -20.7% (lung), -24.4% (heart), -5.9% (spine), -18.7% (eye), and -10.5% (brain). Simulations indicated average dose changes of -33.4% (breast), -20.2% (lung), -18.6% (spine), -20.0% (eye) and -7.2% (brain). ODM reduced dose to the brain and lung tissue, however these tissues would experience up to 15.2% and 13.1% dose increase respectively at noise standard deviation equal to smartmA. ODM reduced dose to the eye lens in 22 of 28 phantoms (-1.2% to -12.4%), had no change in dose for two phantoms, and increased dose for three phantoms (0.7% to 2.3%) with respect to smartmA at equal noise standard deviation. All phantoms demonstrated breast dose reduction (-2.1% to -27.6%) at equal noise standard deviation.

CONCLUSION

Experimental and simulation studies over a range of patient sizes indicate that ODM has the potential to reduce dose to sensitive organs by 5 - 38% with a limited increase in image noise.

CLINICAL RELEVANCE/APPLICATION

Organ-based tube current modulation has the potential to reduce the dose to radiosensitive tissues with limited degradation in noise standard deviation.

SSG15-08  
Monitoring and Controlling Patient Radiation Exposure from Computed Tomography at a Community Hospital Using a Collaborative, Data-driven Approach

Jenifer Willmann Siegelman MD, MPH (Presenter): Consultant, Bayer AG, Marie Kate MacGregor MPH: Consultant, Bayer AG, Mark Patrick Supanich PhD: Research agreement, Siemens AG

PURPOSE

Evaluate the effectiveness an organization-wide stewardship initiative based on a systematic evaluation of radiation dose using automated dose tracking software coupled with targeted interventions that included protocol modification, equipment replacement or software upgrades and operator training

METHOD AND MATERIALS

Design: Retrospective, observational study of consecutive CT exams with a 3-month control, 12 month intervention and 3-month follow-up period in a community health system. Intervention: Periodic analysis of dose by protocol, equipment and operator using automated radiation dose capture software with built-in analytic tools provided the data for the intervention and confirmation of dose optimization. The optimization strategy engaged physicians, physicists, technologists, and hospital administrators and included equipment software upgrades, new equipment, changes in protocol parameters and training/retraining of technologists. Analysis: Pre- and post-intervention radiation dose (surrogate parameters CTDIvol, Dose Length Product (DLP) and Size Specific Dose Estimate (SSDE)) by protocol group was assessed and significance tested using an Analysis of Covariance on log transformed values.

RESULTS

Compared with control period, mean CTDIvol by protocol in the follow up period was reduced by 13% for all head exams and by 22% for all body exams. The difference in mean CTDIvol between the control and follow up period within all protocols was significant. Model R-squared values for analysis of covariance (ANCOVA) ranged from 0.03 to 0.8 and demonstrated equipment and gender as significant covariates. Low model R-squared values for the majority of tests indicated changes in protocol parameters and technique were likely contributors to dose reduction. Analysis of the difference in means pre- and post-intervention by equipment found dose reduction was significant for equipment that was not upgraded during the intervention and for equipment that was upgraded.

CONCLUSION
Systematic review of radiation dose by protocol and by patient demographics combined with an iterative process of image review, education, protocol modification and equipment upgrades resulted in a decrease in radiation exposure to a patient population.

**CLINICAL RELEVANCE/APPLICATION**

Tracking radiation dose by protocol and patient demographics provides information for ongoing, targeted quality improvement and quality control.

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**SSG15-09**

**Calculation of Individualized Organ Dose for CT Patients in National Lung Screening Trial**

**Choonsik Lee PhD (Presenter): Nothing to Disclose , Randell L. Kruger PhD : Nothing to Disclose , Philip F. Judy PhD : Nothing to Disclose , Wesley E. Bolch PhD : Nothing to Disclose , Dianna D. Cody PhD : Nothing to Disclose**

**PURPOSE**

We calculated doses to major organs associated with CT screening examinations for 23,773 CT scans, a subset of the total cohort of the National Lung Screening Trial (NLST), using a library of computational human phantoms coupled with Monte Carlo radiation transport technique.

**METHOD AND MATERIALS**

First, we collected scan parameters (patient ID, age, gender, height, weight, scanner manufacturer, model, scan length, kVp, and mAs) from 23,773 CT scans. Second, organ dose conversion coefficients (organ dose normalized to CTDIvol of a reference CT scanner) was calculated using Monte Carlo code, MCNPX2.7, where experimentally-validated CT scanner simulation was coupled with 193 adult hybrid computational phantoms representing the height and weight of the current U.S. population. Finally, dose to selected organs (lung, heart, and thyroid) were calculated by using the organ dose library and the abstracted scan parameters. The other set of organ doses was also calculated for comparison using organ dose conversion coefficients based on a single adult male phantom with reference body size.

**RESULTS**

We established a comprehensive organ dose library for 193 adult phantoms: six dimensional dose matrix, D (31 organs, 190 slices max, 7 height bins, 19 weight bins, 2 genders, and 6 x-ray spectra). Patient size-specific organ doses were calculated for 23,773 CT scans using the dose library coupled with abstracted technical parameters. Mean doses to lung, heart, and thyroid were 4.5 (SD=1.6), 4.5 (SD=1.6), and 3.7 (SD=2.0) mGy, respectively, while mean CTDIvol was 3.6 mGy (SD=1.2). Organ doses based on the reference size phantom under- or over-estimated the values of thin and obese patients, respectively, up to 60%.

**CONCLUSION**

We calculated individualized doses to major organs for 23,773 CT scans involved in the NLST by using size-dependent computational phantoms coupled with Monte Carlo calculations. The organ dose conversion coefficients and batch calculation technique developed in this study can be also used for other studies including patient dose monitoring, epidemiological studies of cancer risk, and the analysis of CT dose trend.

**CLINICAL RELEVANCE/APPLICATION**

The results from the study provide the individualized organ dose estimations for NLST patient cohort. The dosimetry method used in this study will be useful for calculation patient size-specific organ dose in other studies without performing intensive Monte Carlo simulation.
**SSG16-01**

**Factors Impacting Survival in a Multi-institutional Study of High-risk Neuroblastoma**

Atmaram Pai Panandiker (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose/Objective:** To evaluate factors impacting survival in patients with stage 4 abdominal neuroblastoma.

**Materials/Methods:** Between April 2007 and May 2013, 41 children with neuroblastoma received IMRT to the primary tumor bed as part of a curative protocol. Event-free and overall survival (EFS and OS) were measured from date of diagnosis to death or local/distant first failure as determined by CT scan, MR imaging, or meta-iodobenzylguanidine (mIBG) scintigraphy. The association between outcome and risk factors such as age at diagnosis, gender, cumulative loco-regional radiation dose, MYCN amplification, extent of resection, number of mIBG avid sites pre-induction, and pre-RT was studied using a Cox-regression model.

**Results:** With a median follow-up of 3.5 years from diagnosis, 5 patients died of disease. The 3-year EFS and OS were 61.5% ± 8.8% and 74% ± 7.8%, respectively. Twenty-one (51%) patients exhibited chemorefractory disease post-induction chemotherapy and ten (24%) patients had macroscopic residual disease post-surgery. Six (29%) of 21 children with post-induction chemorefractory distant metastatic disease obtained less than a gross total resection. No loco-regional distant first failure occurred in 14 patients, predominantly in skeletal sites. There was no association between outcome and age, gender, extent of resection, or MYCN amplification. However, a significant association between the number of mIBG avid sites at diagnosis and EFS was observed. In contrast to recently published literature, the number of mIBG avid lesions after induction chemotherapy did not associate with outcome.

**Conclusion:** The number of mIBG avid sites at diagnosis is prognostic of outcome.

**SSG16-02**

**Radiation Oncology & Radiobiology Keynote Speaker: Peds/CNS Tumors**

Martin Colman MD (Presenter): Nothing to Disclose

**SSG16-03**

**A Multidisciplinary Approach In Childhood Craniopharyngioma: Impact on Neuropsychological Functions**

Anna Rita Alitto (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):** Primary aim was to estimateneurocognitive and psychological morbidity in childhood affected bycraniopharyngioma, treated by surgery and radiotherapy; secondary endpoint wasthe assessment of overall survival (OS) and progression free survival (PFS).

**Materials/Methods:** A retrospective analysis was conducted in patients with craniopharyngioma treated by surgery and radiotherapy (RT). The indications for RT were: repeated surgery with residual mass, inoperable symptomatic or recurrence lesions. A total dose of 5040 cGy in 180 cGy/fraction was administered to tumoral bed + residual mass. Acutetoxicity was evaluated according to RTOG scale. A multidisciplinary follow-up was performed for all patients with radiation oncologist, neurosurgeon and neuropsychologist. A detailed and systematic cognitive (Griffith’scale and Wechsler scale) and neuropsychological evaluation was performed in three precise moments: diagnosis (T0), one month after neurosurgical treatment (T1), and 2 years after radiotherapy (T2). A statement of Quality of Life was reported with PedQOLquestionnaire. **Results:** Analysis was performed on nine patients, with median age of 6 years (4 - 12) at time of diagnosis and 8 years (5-14 yrs) at beginning of RT. All patients presented residual mass and sixpatients underwent repeated surgery. Grade I skin, haematological andneurological acute toxicity was observed in 3 patients, reversible in all cases. IQ was normal in all patients at T0, T1 and T2, without significant differencebetween different timing. The systematic review of specific neuropsychological disorders showed: visuospatial disorders in six patients (67%), both in T0 and T2, an impairment of immediate recall and working memory at differenttimes; short term memory and working memory in five patients in the lastfollow-up. These results seemed correlating to decreased of attention systemprocessing, while language skills and praxia as executive function were preserved. Self perception scale was impaired at the last follow up. TheirPedQOL results was compatible with average range in 6 patients (67%) and low inthree cases (33%). In summary, no significant disorders were reported. Allpatients are alive with disease, with a median follow-up of 73 months from diagnosis 1117 and of 49 months from RT (27-81). One patient presented recurrence at 3 months from radiotherapy. 5 yrs PFS was 89%, while median PFS had not yet reached. **Conclusions:** Specific neuropsychological disorders seems acceptable in long time survivors. These data demonstrate the importance of multidisciplinary and expert approach to childhoodcraniopharyngioma. This time of approach also allows systematic and specific interventions in selected cases.

**SSG16-04**

**Patterns of Failure for Pediatric Glioblastoma Multiforme Following Radiation Therapy**

Jacob Shabason (Presenter): Nothing to Disclose, David Lustig MD: Nothing to Disclose, Christine Hill-Kayser: Nothing to Disclose, Robert A. Sutton MS: Nothing to Disclose

**ABSTRACT**

**Purpose/Objectives:** Despite aggressive multimodal therapy for pediatric glioblastoma multiforme (GBM), survival remains poor. Retrospective adult studies have shown that most GBMs recur within the high-dose radiation field. To our knowledge, no such studies have been performed in the pediatric population. As such, this study aims to evaluate the patterns of failure in pediatric patients with GBM after radiation therapy (RT).

**Materials/Methods:** We conducted a retrospective review of 13 pediatric patients treated with RT for GBM from 2007-2013. Patients were treated with intensity-modulated radiation therapy (IMRT) or proton therapy, with treatment volumes defined using residual disease, surgical bed, edema, and 2 cm margin. First failure MRI scans were fused with treatment planning scans. Patterns of failure were defined as: in-field (>= 95% of recurrence volume in the 95% isodose of the volume >= 45 Gy), marginal (Results: The patients had a mean age of 12.2 years (range 2-22) and were 53.8 % female. Seven patients (53.8%) underwent gross total resection (GTR), 5 (38.5%) had subtotal resection (STR), and 1 (7.7%) had a biopsy only. Twelve patients were treated with IMRT, and 1 was treated with proton therapy. Patients were treated to a mean total dose of 56.7 Gy (range 50.4 Gy-60 Gy), with dose reduced below 54 Gy for 2 patients who received prior radiation for other types of malignancies. Most patients (92.3%) were treated with concurrent chemotherapy: 10 with temozolomide, 1 with capectabine, and 1 with temozolomide and bevacizumab. With a median follow up of 52.8 months, 9 patients (69.2%) developed recurrent disease. Of recurrences, 2 (22.2%) were in-field, and 1 (11.1%) was distant. Median OS and PFS were 18.2 months and 16.3 months,
Conclusions: The majority of patients treated with adjuvant radiation fall in the region of high-dose RT, indicating the need for improvements in local therapy. These may include radiation dose escalation and novel radiosensitizing agents.

SSG16-05  
Survival Outcomes for Unresected Non Metastatic Osseous Ewing’s Sarcoma in Pediatric Patients Treated with Combined Modality Treatment: A Single Institution Experience

Pablo Munoz Schuffenecker (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): To evaluate the outcomes of unresected non metastatic Ewing's sarcoma in pediatric patients treated with 3DCRT and chemotherapy at a single institution.Materials/Methods: The records of 21 patients diagnosed with non-metastatic Ewing's sarcoma who did not undergo surgical resection and were treated with induction chemotherapy (including vincristine, doxorubicin, cyclophosphamide, ifosfamide and etoposide) followed by definitive chemo and CT based radiation therapy to the primary site between 1997 and 2013 were reviewed. All patients received chemotherapy.Results: Twenty patients met the inclusion criteria and were included in this analysis. Median age was 13 years (range: 4-16). 17 patients had a primary located in the axial skeleton. Radiation doses ranged from 14.4 to 55.8 Gy (median: 43Gy). Actuarial 3 year local control was: 80%. 3 year overall survival was: 70%. The median follow up for surviving patients was 152 months.

SSG16-06  
Outcomes of CNS Germ Cell Tumor Patients Treated with Intensity Modulated Radiation Therapy and Volumetric Modulated Arc Therapy to Whole Ventricle

Ana Carolina Rezende (Presenter): Nothing to Disclose, Eduardo Weltman: Nothing to Disclose, Juliana Karassawa Helito: Nothing to Disclose, Michael Chen: Nothing to Disclose, Nasjla Saba: Nothing to Disclose, Andrea Cappellano: Nothing to Disclose, Jose Carlos Cruz: Nothing to Disclose, Roberto Sakuraba: Nothing to Disclose

ABSTRACT

Purpose / Objectives: Intracranial germ cell tumors are a heterogeneous group of neoplasms with high cure rates due to its sensitivity to radiation and chemotherapy (CT). However, recurrences are not uncommon after focal-field radiotherapy (RT) and the whole ventricle irradiation appears to be a more attractive approach in this scenario. The aim of this retrospective study is to report our experience in treating these tumors with CT followed by Intensity Modulated Radiation Therapy (IMRT) to whole ventricles and a tumor bed boost.

Methods and Materials: Between January 2006 and January 2014, 24 patients with pathologically or clinically diagnosed CNS Germ cell tumors were reviewed at our institution. The first treatment approach was based on CT combined to RT, and 7 patients underwent tumor resection as well. All of them had whole ventricle irradiation with doses ranging from 18 Gy to 36 Gy, and 22 patients received an additional tumor bed boost ranging from 30.6 Gy to 54 Gy. IMRT was the technique of choice in all these cases and Volumetric Modulated Arc Therapy was used to treat 66% of them. The outcomes were recorded.

Results: The 24 patients are alive, although three recurred with time to relapse ranging from 4 to 26 months. All of them had cranial spinal fluid (CSF) recurrence and two presented with spinal nodules. They were all treated with CT followed by a second course of radiation, consisting on craniospinal radiotherapy with an additional dose to spine residual masses. The 3 patients are alive, and only one of them has persistent disease.

Conclusions: Whole ventricle irradiation following CT seems to be an effective approach for intracranial germ cell tumors. Efforts should be made to better identify the risk factors for spinal spread and provide an adequate selection of the best candidates for whole ventricle irradiation.
SSG16-08

Vertebral Body Sparing in Wilm’S Tumor: Comparison between 3d-crt Vs Vmat

Hina  Saeed MD (Presenter):  Nothing to Disclose, Selim Yusuf  Firat MD :  Nothing to Disclose, Douglas  Prah :  Nothing to Disclose

ABSTRACT

Purpose/Objective(s):Advances in multimodality treatment have significantly improved the survival rates of patients with Wilm’s tumor. Per Wright et al., the current 8-year survival rate for most patients who have favorable-histology tumors is 80-98%. Standard fields used for flank irradiation can detrimentally affect the growth of the spine (decrease in sitting height and modest decrease in standing height). These effects are more pronounced the younger the patient is at the time of RT. There is also an increased risk of osteoporosis especially involving the spine) and degenerative disease. The degree of damage depends on the total dose, fractionation, and field of radiation. Treating only part of the vertebral column, as used in flank irradiation before 1960, resulted in differential growth of the spine and subsequent development of spinal deformities, but using an altered technique in which the entire vertebral body is irradiated prevented some of the severe deformities. However, per Wright et al, studies continued to report occurrence rates of kyphosis and scoliosis between 10% and 70%, the wide range reflecting the difference between clinical and radiological evaluation. Here, we compare 3-D conformal RT to volumetric modulated arc therapy (VMAT) in a primary Wilm’s tumor case to assess vertebral body sparing.

Materials/Methods: Vertebral body sparing radiotherapy was planned on a left sided, favorable histology Stage III Wilm’s tumor. The CTV and PTV were delineated according to ARENO0532 guidelines. The tumor bed was contoured as a CTV and PTV of 1cm was generated around the CTV, also accounting for organ motion. The vertebral bodies and intervertebral discs were contoured. 10.8 Gy in 6 fractions were prescribed to 95% of PTV, while reducing the dose to the remaining kidney as low as possible. Plans were generated using standard 3D-CRT and VMAT and were analyzed to assess vertebral body sparing.

Results: VMAT plan was dosimetrically superior to 3D-CRT plan. The volume of PTV receiving 10.8 Gy was 88% and 95% for 3D-CRT and VMAT, respectively. The volume of the right kidney receiving greater than 5 Gy was 14% and 4.4% for 3D-CRT and VMAT, respectively. For the left kidney, the volume receiving greater than 3 Gy was 3.4% versus 96% for VMAT and 3D-CRT respectively.

Conclusions: Use of VMAT for Wilm’s tumor can provide significant dosimetric advantages over 3D-CRT in delivering the desired dose to the PTV while minimizing the dose to the vertebral bodies in an attempt to avoid any musculoskeletal or growth abnormalities in the future.

SSG16-09

Preoperative Radiotherapy of Soft Tissue Sarcoma a Single Institute Experience

Ayca   Iribas (Presenter):  Nothing to Disclose

ABSTRACT

PURPOSE: Assessment of the outcomes of preoperative radiotherapy (RT) ± chemotherapy (ChT) administered to patients with soft tissue sarcoma (STS) in our Institute.MATERIAL: Preoperative RT was applied to 131 pts with STS between the years of 1996 and 2010 in Istanbul Univ. Institute of Oncology. 65 (50%) of the patients (pts) were male, 66 (50%) were female. 109 of the pts had a T2 tumour and 22 had a T1 tumour. The tumours were located in the extremities in 113 pts and 18 pts non-extremity. Their histopathological diagnosis were fusiform sarcoma, 26 pts-synovial sarcoma; 15 pts-plasmacytoid sarcoma; 11 pts-mesenchymal sarcoma, 10 pts-malign fibro histiocytoma, 15 pts-other kinds of sarcoma.

Median tumour size was 9 cm (4-25 cm). Preoperatively, 28 Gy/8 fr RT was applied as external RT to 115 pts. 16 pts received 45-50 Gy /23-25 fr in the same manner. Preoperative response to post-RT were as follows: 96 pts (73%)-partial response; 19 (15%)-stable response; 11 (8%)-no response. The method of surgery was concerned (86 % vs 64%, p=0.025). ChT was applied to pts with a high grade and high risk of metastasis. Accordingly, prognosis in pts who received ChT was determined to be better than in those who did not (87% vs. 65%, p: 0.04). In pts who developed metastasis the prognosis was poor (88% vs. 44%, p= 0.000). The rate of the occurrence of a wound healing problem due to preoperative RT was 4%.

CONCLUSIONS: Extremity sarcoma, 11 pts-mesenchymal sarcoma, 10 pts-malign fibro histiocytoma, 15 pts-other kinds of sarcoma.

UVA revealed that a tumour diameter of 10 cm was a significantly negative prognostic factor as far as 5-yr OS rate is concerned (86 % vs 64%, p=0.025). ChT was applied to pts with a high grade and high risk of metastasis. Accordingly, prognosis in pts who received ChT was determined to be better than in those who did not (87% vs. 65%, p: 0.04). In pts who developed metastasis the prognosis was poor (88% vs. 44%, p= 0.000). The rate of the occurrence of a wound healing problem due to preoperative RT was 4%.

Hologic: 3D Breast Biopsy using the Selenia® Dimensions®, Affirm™ and Eviva® systems.

Vendor Workshops

Tue, Dec 2 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 CEU.
BRS-TUA

Breast Tuesday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits ™: .50

Tue, Dec 2 12:15 PM - 12:45 PM  Location: BR Community, Learning Center

Participants

Moderator

Emily F. Conant MD : Scientific Advisory Board, Hologic, Inc

Sub-Events

BRS257 How Sensitive is Contrast-enhanced Spectral Mammography (CESM) versus Breast MRI?—Initial Retrospective Comparison in 50 Malignant Breasts (Station #1)

Luna Li MD, PhD : Nothing to Disclose, Lydia Liao MD, PhD : Nothing to Disclose, Pauline Germaine DO : Nothing to Disclose, Elizabeth Tinney RRA (Presenter): Nothing to Disclose

PURPOSE

To compare contrast-enhanced spectral mammography (CESM) with breast MRI (BMRI) in a retrospective study in breast cancer detection. To further understand the features and benefits of CESM as a diagnostic tool.

METHOD AND MATERIALS

This study involved 50 malignant breasts in 48 women retrospectively chosen from of 960 patients in our institution. Both CESM and BMRI were done for each patient within 30 days. The positive findings were confirmed by pathology reports. The number of malignant lesions was quantified. The size of lesions was classified into three categories based on standard of breast cancer stages. The enhancement intensity on both studies has been quantified based on a scale of 0-3. The scores of each case were calculated for average size of index lesion and statistical analysis. Sensitivity and positive predictive value (PPV) were calculated for each study. Morphology consistence was evaluated by the percentage of the consistent findings between CESM and BMRI.

RESULTS

Our retrospective study analyzed the sensitivity and PPV of CESM by comparing to BMRI. Of the 50 breasts, there was one false-positive finding at CESM mammography, and four false-positive findings at MR imaging. The average size of index lesion examined was 3.7cm by CESM and 3.8cm by BMRI. The smallest cancer can be detected by both CESM and BMRI is less than 0.5 cm. The average staging was 2 for both CESM and BMRI. The score for cancer enhancement intensity is 1.8 for CESM and 2.2 for BMRI. Both CESM and BMRI have a sensitivity of 100% to detect breast cancer in our study. CESM has a PPV of 98% versus 93% for BMRI which reflects a better specificity. Morphology consistence was 46/50 (92%).

CONCLUSION

CESM and BMRI are consistent on morphology and equal sensitivity for detection of breast cancer lesions. CESM has less enhancement intensity than BMRI and higher PPV (reflecting a higher specificity) than BMRI.

CLINICAL RELEVANCE/APPLICATION

With its low cost, increased accessibility, feasibility, and short test duration, CESM can be used as a triage method before BMRI is applied.

BRS258 BI-RADS Classification before and after Contrast Enhanced Spectral Mammography. Possible Indications and Usefulness as a Complementary Tool in Management of Breast Lesions (Station #2)

Juan Jose Cordones (Presenter): Nothing to Disclose, Carolina Ramirez Lozano MD : Nothing to Disclose, Jose Luis Cardenas : Nothing to Disclose, Johanna Marisol Silva MD : Nothing to Disclose, Carmen Bermejo : Nothing to Disclose, Angeles Cruz Diaz MD : Nothing to Disclose

PURPOSE

To describe how CESM changed BI-RADS category of lesions previously evaluated with conventional imaging modalities reviewing the cases performed in our institution from March 2011 to February 2013.

METHOD AND MATERIALS

We reviewed the indications of 95 patients with CESM performed at our institution and we analyzed how the BI-RADS category was modified according to the lack, presence and degree of enhancement on CESM in a total of 95 cases.
of 108 lesions, comparing it with the BI-RADS obtained in mammography and/or ultrasound. We correlated radiologic findings with histopathological findings (80) or radiologic follow-up of at least one year when no biopsy was performed (28).

RESULTS

We consider the performance of CESM indicated in the following situations: lack of conclusive findings on mammography and / or ultrasound (33), mismatch between different imaging modalities or between histologic and radiologic diagnosis (30), post-surgical changes making it difficult to rule out local recurrence on conventional tests (13), planning interventional procedures in cases of multiple lesions (18), and dense breasts with suspicious lesions (14). In 29 of 108 lesions, CESM determined a change in the BI-RADS category previously obtained with other radiological modalities. 80 lesions were biopsied and 28 went into radiological follow up. 95% of non enhancing lesions and 67% of those with low intensity enhancement were benign. Presence of malignant cells was confirmed in 93% of high intensity enhancing lesions.

CONCLUSION

Although studies with significant samples are needed to establish clear indications of CESM, our experience proves it is useful to various diagnostic scenarios as a complementary tool, determining in a significant number of cases a change in the diagnostic management of injuries. Accessibility is a remarkable advantage of this modality.

CLINICAL RELEVANCE/APPLICATION

CESM could be a useful tool in the assessment of lesions of questionable findings, evaluation of dense breast and as a complementary tool to mammography and ultrasound in the study of scars. Accessibility is a remarkable advantage of this exploration since we can use it in the same diagnostic act and requires little room occupancy time.

BRS259

Preoperative Breast Cancer Staging with Contrast Enhanced Spectral Mammography (CESM) in Comparison to Breast Ultrasound: Preliminary Results (Station #3)

Katrin S. Blum MD (Presenter): Nothing to Disclose, Christian Rubbert MD: Fellowship funded, Koninklijke Philips NV, Britta Mathys MD: Nothing to Disclose, Gerald Antoch MD: Speaker, Siemens Medical AG, Speaker, Bayer AG Speaker, BTG International Ltd, Svjetlana Mohrmann MD: Nothing to Disclose, Silvia Obenauer MD: Nothing to Disclose

PURPOSE

To prospectively evaluate and compare the accuracy of CESM and ultrasound in size measurement of breast cancer with histologic tumor sizes as gold standard. Artifacts impeding tumor size measurements in CESM were assessed in addition.

METHOD AND MATERIALS

21 women aged between 40-73 years (mean age 56 y +/-9 y) with histologically proven ductal carcinoma in situ (DCIS) alone, invasive ductal/lobular carcinomas with or without additional DCIS were included in the study. Breast density of patients was classified by the standardized classification system of the American College of Radiology (ACR)’s Breast Imaging Reporting and Data System ACR1-4. Largest tumor diameter in each method was taken as tumor size in each patient. Agreement of imaging tumor size and histopathologic tumor size was evaluated with Bland-Altman analysis.

RESULTS

Motion artifacts did not occur in the study. CESM specific artifacts caused by scattered radiation did not cause any problems in tumor size measurement. In four patients additional enhancement caused most likely by hormone proliferation of breast tissue was seen. Ultrasound in general underestimated tumor size while CESM tumor size measurements lead to a slightly overestimation of tumor size. Mean differences of tumor sizes measurement with CESM was 0.14mm (5.33%) compared to -3.05mm (-11.99%) with ultrasound. Limits of agreement ranged from -18.6 to 18.9mm for CESM, and -19.5 to 13mm in CESM. Especially tumors with size smaller than 23mm were measured more precise with CESM, than tumors with larger size. Ultrasound underestimated tumor size in women with ACR4 breast tissue density.

CONCLUSION

Similar to MRI CESM leads to a small overestimation of tumor size whereas ultrasound tends to underestimate tumor size. Motion artifacts do not affect CESM images due to strong compression and fixation of the breast. Hormone proliferation causes enhancement of healthy breast and scattered radiation artifact is a special artifact of CESM, which did not affect tumor size measurement in this study.

CLINICAL RELEVANCE/APPLICATION

Breast cancer tumor size and distribution in the breast is important to plan the most adequate therapy. Initial results with CESM show that tumor size measurement with CESM is superior to tumor size measurements with breast ultrasound.

BRS260

Effect of Gadolinium Injection on Diffusion-weighted Imaging with Background Body Signal Suppression (DWIBS) Imaging of Breast Lesions (Station #4)

Marco Moschetta MD (Presenter): Nothing to Disclose, Michele Telegrafo: Nothing to Disclose, Leonardo Rella: Nothing to Disclose, Davide Antonio Carluccio: Nothing to Disclose, Amato Antonio Stabile Ianora: Nothing to Disclose, Giuseppe Angelelli: Nothing to Disclose
**PURPOSE**

Diffusion-weighted imaging with background body signal suppression (DWIBS) has improved DWI potential by using a short TI inversion recovery (STIR)-echo planar imaging (EPI) sequence and free breathing to screen for breast lesions. DWIBS MR sequences provide both qualitative and quantitative imaging of breast lesions and are usually performed before contrast material injection (CMI) in the course of breast MR scan protocol. This study aims to assess whether the administration of gadolinium significantly affects DWIBS imaging.

**METHOD AND MATERIALS**

200 patients were prospectively evaluated by MRI with STIR, TSE-T2, pre-CMI DWIBS, contrast enhanced THRIVE-T1 and post-CMI DWIBS sequences. Pre and post-CMI DWIBS were analyzed searching for the presence of breast lesions and calculating the ADC value. ADC values of ≤1.44x10⁻³ mm²/s were considered suspicious for malignancy. This analysis was then compared with the histological findings. Sensitivity, specificity, diagnostic accuracy (DA), positive predictive value (PPV) and negative (NPV) were calculated for both sequences and represented by ROC analysis. Pre and post-CMI ADC values were compared by using the paired t test.

**RESULTS**

In 150/200 (59%) patients, pre and post-CMI DWIBS indicated the presence of breast lesions, 53 (35%) with ADC values of >1.44 and 97 (65%) with ADC ≤ 1.44. Both pre-CMI and post-DWIBS sequences obtained sensitivity, specificity, DA, PPV and NPV values of 97%, 83%, 89%, 79% and 98%, respectively. The mean ADC value of benign lesions was 1.831 ± 0.18 × 10⁻³ mm²/s before and 1.828 ± 0.18 × 10⁻³ mm²/s after CMI. The mean ADC value of the malignant lesions was 1.146 ± 0.16 × 10⁻³ mm²/s before and 1.144 ± 0.16 × 10⁻³ mm²/s after CMI. No significant difference was found between pre and post CMI ADC values (p > 0.05).

**CONCLUSION**

DWIBS imaging represent a useful diagnostic complement for characterizing breast lesions and its diagnostic accuracy is not influenced by CMI. Breast MR protocol could be modified by placing DWIBS after dynamic contrast enhanced sequences in order to maximize patient cooperation and preserve the diagnostic accuracy of breast MRI.

**CLINICAL RELEVANCE/APPLICATION**

DWIBS sequences are not influenced by gadolinium injection. Breast MR protocol could be modified by placing DWIBS after dynamic contrast enhanced sequences in order to maximize patient cooperation and preserve the diagnostic accuracy of breast MRI.

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**BRS261**

The Predictive Value of BI-RADS Descriptors and Genetic Variants in Women Undergoing Breast Biopsy (Station #5)


**PURPOSE**

Recent large-scale genome-wide association studies (GWAS) have identified new genetic variants that predict breast cancer. However the predictive ability of genetic variants compared to mammography (BI-RADS) features has not been evaluated. We conducted a retrospective case/control study to determine the predictive value of demographic risk factors (from the Gail model), germline genetic variants, and BI-RADS abnormality features in women undergoing image-guided breast biopsy.

**METHOD AND MATERIALS**

We collected age-matched cases and controls from a population-based Personalized Medicine Research Project (PMRP), including women of Western European heritage with a plasma sample, a mammogram, and a breast biopsy within 12 months after the mammogram. We used Gail model risk factors from surveys and the EMR, mammographic findings according to BI-RADS extracted from free text reports, and 10 germline genetic variants (single nucleotide polymorphisms-SNPs). We built conditional logistic regression models to determine the predictive ability of single data types: 1) Gail, 2) SNPs and 3) BI-RADS as well as combined data types: 1) Gail + SNPs, 2) Gail + BI-RADS and 3) Gail + SNPs + BI-RADS. We evaluated each model in turn by calculating a risk score for each patient (using 10-fold cross validation); used this risk estimate to construct ROC curves; and compared the AUC of each model using the DeLong method.

**RESULTS**

With 373 cases and 395 controls, we found that models developed using a single data type, BI-RADS (AUC = 0.681) was superior to the Gall (AUC = .579; p < 0.001) and SNPs (AUC = .601; p < 0.001). Each data type augmented the baseline Gall model: Gall + SNPs (AUC = .622; p < 0.02), Gall + BI-RADS (AUC = .700; p < 0.001) and Gall + SNPs + BI-RADS (AUC = .718; p < 0.001).

**CONCLUSION**

Using a single data type, BI-RADS features were most predictive of breast cancer in this population. When combined, each data type augmented discriminative performance.

**CLINICAL RELEVANCE/APPLICATION**

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As genetic disease prediction gains momentum, we show that BI-RADS abnormality features alone outperform and together augment demographic and genetic risk factors in the prediction of breast cancer.

Spectral CT and Malignant Breast Lesions: Initial Findings (Station #6)

Phil Frans Lodewijk Ardies MD (Presenter): Nothing to Disclose, Lenz Ardies MD: Nothing to Disclose, Erwin Oomms MD: Nothing to Disclose

PURPOSE
Spectral CT or single source dual-energy CT is a recently introduced scan technique. The purpose of this survey was to discover whether spectral CT has an additional value in the diagnosis and staging of malignant breast lesions and in the follow-up during treatment.

METHOD AND MATERIALS
Spectral CT was performed in two groups of patients: patients with no suspicion for underlying breast malignancy who had a chest CT for pulmonary or pleural pathology and patients with a chest CT for staging of a suspected or biopsy proven breast malignancy. Spectral CT was also used in the follow-up of patients during treatment for breast malignancy. Spectral CT images were viewed both qualitative as quantitative. Qualitative analysis was done by looking both at grayscale and color coded images, quantitative analysis was performed by measuring iodine content and using spectral attenuation curves. Results were compared to other imaging techniques as MRI and to pathology findings.

RESULTS
Between September 2012 and March 2014 26 patients with biopsy proven breast cancer were staged with a spectral chest CT. Results were compared to MRI and postoperative pathology findings. All lesions (single or multifocal) were found on spectral CT, due to the higher iodine content in the malignant lesion compared to the surrounding breast tissue. Analysis of axillary lymph node involvement was done by comparing iodine content of the nodes with that of the primary lesion and the contralateral nodes. Spectral CT was also helpful in patients with suspected breast pathology with negative mammography and ultrasound when MRI could not be performed and was also able to detect several unsuspected breast malignancies on routine chest CT. Spectral CT was also used in the follow-up of patients during treatment to evaluate not only tumor size but also iodine concentration as a measure for residual tumor activity.

CONCLUSION
Spectral CT has a clear advantage over conventional CT in detecting breast cancer and can be an important additional tool in selected cases when breast MRI cannot be performed. After treatment of breast cancer spectral CT can evaluate tumor response to treatment both by measuring tumor size and iodine content as a measure for tumor activity.

CLINICAL RELEVANCE/APPLICATION
Spectral CT is a new technique which is used in abdominal and thoracic oncologic imaging. The aim of our survey was to explore the possible use of spectral CT in breast imaging.

Can We Use the Manufacturer Reported Mammography Dose to Inform Patients? (Station #7)

Stamatia V. Destounis MD (Presenter): Investigator, FUJIFILM Holdings Corporation Investigator, Seno Medical Instruments, Inc, Ralph Philip Highnam PhD: CEO, Matakina Technology Limited CEO, Volpara Solutions Limited, Ariane Chan PhD: Employee, Matakina Technology Limited, Andrea Lynn Arieno BS: Nothing to Disclose, Renee Morgan RT: Nothing to Disclose

PURPOSE
To evaluate the radiation doses reported by manufacturers for women undergoing mammographic screening over time, in the context of dose reporting to patients.

METHOD AND MATERIALS
Mammographic images of women undergoing yearly mammography screening at our facility were retrospectively analyzed. We identified 30 women who had 4 or 5 temporal studies complete with 4-view mammograms taken from a mix of three manufacturers (System 1, System 2, and System 3) digital mammography systems. Raw digital images were used in this evaluation. The manufacturer reported mean glandular dose (MGD) was extracted from the image headers and compared over time, considering also the technical factors and volumetric information generated by VolparaDensity (algorithm version 1.5.8). All MGD values presented were taken as the average (mean) per image across a 4-view study.

RESULTS
The manufacturer-reported radiation doses for the same patient were highly variable over time. The absolute mean change (between sequential studies) in MGD was 0.72 mGy, with changes ranging from -2.87 to +4.31 mGy. For instances where dose increased compared to the previous year, the average increase in MGD and average percentage increase, were 0.8 mGy and 62.1%, respectively. For instances where dose decreased compared to the previous year, the average decrease in MGD and average percentage decrease, were -0.6 mGy and -11.7%, respectively. Changes in MGD were not significantly influenced by changes in breast density (quantitative volumetric or BI-RADS scores); however, the manufacturer did significantly influence changes in MGD as a significantly higher average MGD was found when comparing System 1 and System 2 (3.5 and 1.4 mGy, respectively; p < 0.001).
CONCLUSION

Manufacturer-reported radiation doses vary considerably over time and between manufacturer, due to differences in technology, as well as differences in how they compute dose. This is important as patients are becoming increasingly concerned about radiation dose.

CLINICAL RELEVANCE/APPLICATION

Radiation dose is becoming a major concern, not only for general radiology, but also for mammography. The delivery of meaningful dose reports to patients is hindered by the wide variation in manufacturer reported doses.

BRE149

Introductions of Current and New Breast Diffusion MRI Techniques: Potential Alternative to Contrast-enhanced MRI Technique (Station #8)

Ken Yamaguchi MD (Presenter): Nothing to Disclose, Takahiko Nakazono MD, PhD: Nothing to Disclose, Tomoyuki Noguchi: Nothing to Disclose, Ryoko Egashira MD: Nothing to Disclose, Hiroyuki Abe MD: Consultant, Seno Medical Instruments, Inc, Hiroyuki Irie MD, PhD: Nothing to Disclose, Yukiko Hara MD: Nothing to Disclose, Tetsuyoshi Hirai MD: Nothing to Disclose

TEACHING POINTS

1: To review the current breast diffusion MRI (principles including image acquisition, b factor, ADC value, fat suppression and current clinical value) 2: To introduce new breast diffusion MRI techniques including diffusion tensor imaging (principles and comparison with standard diffusion techniques), readout-segmented echo-planar imaging (principles and comparison with standard diffusion techniques) and diffusion weighted imaging of axillary lymph node 3: To demonstrate the clinical value of these new breast diffusion MRI techniques

TABLE OF CONTENTS/OUTLINE

Content Organization 1: The principle and clinical value of current breast diffusion MRI 2: Introductions and prospects of new breast diffusion MRI techniques 2-1: Breast diffusion tensor imaging 2-2: Breast diffusion MRI based on readout-segmented echo-planar imaging 2-3: Diffusion MRI of the axillary lymph node

BRE179

Diagnosis, Treatment, and Follow-Up of Radiation Associated Angiosarcoma (RAA) of the Breast – What Radiologists Need to Know (Station #9)

Sona Ajit Chikarmane MD (Presenter): Nothing to Disclose, Eva Csilla Gombos MD: Royalties, Amirsys, Inc, Angela A. Giardino MD: Nothing to Disclose

TEACHING POINTS

RAA is an aggressive malignancy that can develop years after breast irradiation and may be difficult to detect clinically in a background of radiation-induced skin changes; RAA may also be obscured by expected post-treatment changes (e.g. architectural distortion, skin thickening) on conventional imaging (mammogram and ultrasound[US]). Earlier detection and treatment has been shown to improve survival. The purpose of this exhibit is to 1) review the pathology and demographics of RAA, 2) demonstrate the role of imaging in the diagnosis and management of RAA and 3) illustrate challenging cases with emphasis on multimodality imaging.

TABLE OF CONTENTS/OUTLINE

1. Review demographics, clinical presentation, and pathology of patients with RAA 2. Illustrate how imaging (mammography, US, and breast/chest wall magnetic resonance imaging [MRI]) is used in diagnosing RAA, with emphasis on MRI 3. Highlight role of imaging in staging, surgical planning, treatment response, and detecting recurrences/metastases 4. Discuss a multidisciplinary approach to treatment and management, focusing on conventional chemotherapies, new molecular targeted therapies and surgical options 5. Review challenging cases of RAA on mammography, US, and MRI, ranging from initial diagnosis to metastatic patterns, and draw examples from our tertiary care cancer center’s radiology and pathology database

CAS-TUA

Cardiac Tuesday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits ™: .50

Tue, Dec 2 12:15 PM - 12:45 PM Location: CA Community, Learning Center

Participants

Moderator
Ethan J. Halpern MD : Nothing to Disclose
Moderator
Hajime Sakuma MD : Research Grant, Siemens AG Research Grant, Koninklijke Philips NV Research Grant, General Electric Company Research Grant, Bayer AG Research Grant, Guerbet SA

Sub-Events
Reproducibility and Detectability of the Coronary Artery Calcium Score using Thinner Slices and Iterative Reconstruction at 320-detector CT (Station #1)

Chikako Fujioka RT (Presenter): Nothing to Disclose, Yoshinori Funama PhD: Nothing to Disclose, Kazushi Yokomachi RT: Nothing to Disclose, Masao Kiguchi RT: Nothing to Disclose, Fuminari Tatsugami: Nothing to Disclose, Kazuo Awai MD: Research Grant, Toshiba Corporation Research Grant, Hitachi Ltd Research Grant, Bayer AG Research Consultant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd., Minoru Ishiiro: Nothing to Disclose

PURPOSE

While 3.0-mm-thick slices are commonly used for calcium scoring at cardiac CT, the results vary widely and small calcium deposits can go undetected due to the partial volume effect. Using thinner slices reduces this effect but increases the image noise. Positing that the use of 0.5-mm-thick slices and adaptive iterative reconstruction (IR) reduces both the image noise and the partial volume effect and yields reproducible calcium scores at cardiac CT, we compared results obtained with 3.0-mm-thick slices and with 0.5-mm-thick slices plus IR.

METHOD AND MATERIALS

We scanned a cardiac CT calibration phantom (QRM, Germany) that featured different calcium hydroxyapatite concentrations on a 320-detector CT scanner (Aquilion One, Toshiba) with prospective ECG-triggering. We scanned the phantom 5 times and reconstituted images from same row data. We applied 4 IR strength levels (weak, mild, standard, strong; adaptive iterative dose reduction 3D: AIDR-3D; Toshiba) to the images of 0.5-mm-thick slices, calculated the Agatston scores on a workstation, and compared the variation coefficients to evaluate reproducibility and calcium detectability among the scans.

RESULTS

The average Agatston score for 3.0- and 0.5-mm slices without a filter was 808 and 768; it was 749, 724, 714, and 721 for 0.5 mm slices with weak, mild, standard, and strong IR, respectively. The total mean variation coefficient of the Agatston score for 3.0- and 0.5 mm slices without IR was 5.4 and 2.9; for 0.5 mm slices with weak, mild, standard, and strong IR it was 3.6, 2.1, 2.2, and 2.5%. The detection efficiency for small calcium deposits on 3.0- and 0.5-mm slices without a filter was 53- and 100%; for 0.5-mm slices with weak, mild, standard, and strong IR it was 100-, 100-, 100-, and 83%.

CONCLUSION

Using 0.5 mm-thick slices and IR reduced variations and improved detection for calcium scoring at cardiac CT.

CLINICAL RELEVANCE/APPLICATION

The use of 0.5-mm-thick slices and iterative reconstruction yielded higher reproducibility and calcium detectability for coronary artery calcium scoring without an increase in the radiation dose.

Cardiac CT in Atrial Fibrillation Therapy: Using the Pulmonary Vein Ovality Index for Selecting Ablation Technique (Station #2)


PURPOSE

Recent studies report decreased procedural success in ablation therapy of atrial fibrillation (AF) when cryoballoon ablation is applied to pulmonary vein (PV) ostia with an overly non-circular, oval shape. We used cardiac CT data of a large patient cohort to evaluate whether this also holds true for an approach using wide circumferential radiofrequency ablation (WACA).

METHOD AND MATERIALS

We evaluated data of 260 patients with AF who had undergone WACA. All patients routinely underwent 30 day holter-ECG to assess procedural success as well as cardiac dual-source CT to exclude post-procedural complications. PV measurements were performed in a plane perpendicular to the center-line of each PV at 10 mm from the junction of the PV and the left atrium. The ovality index was calculated for all PVs and was defined as follows: 2x(maximal diameter-minimal diameter)/(maximal diameter+minimal diameter).

RESULTS

The minimal index of ovality in patients with AF recurrence was 0.20±0.10 for the left superior PV (LSPV), 0.23±0.14 for the left inferior PV (LIPV), 0.19±0.10 for the right superior PV (RSPV), and 0.17±0.10 for the right inferior PV (RIPV). In successfully treated patients without recurrence of AF the minimal ovality index was 0.20±0.16 for LSPV, 0.27±0.16 for LIPV, 0.19±0.11 for RSPV, and 0.18±0.12 for RIPV. The maximal index of ovality was 0.43±0.19 for LSPV, 0.47±0.20 for LIPV, 0.40±0.15 for RSPV, and 0.41±0.15 for RIPV for patients with no AF recurrence. For patients with recurrence of AF the maximal ovality index was 0.43±0.14 for LSPV, 0.45±0.17 for LIPV, 0.40±0.14 for RSPV, and 0.42±0.17 for RIPV. There were no significant differences in the minimal or maximal ovality indices between the two patient groups (p>0.05).
CONCLUSION
While previous studies have described an important impact of PV ovality on clinical outcome after cryoballoon ablation, we did not find a significant influence of the PV ovality index on ablation success when using WACA as the ablation strategy. Accordingly, the ovality index may aid in selecting the most promising ablation technique for the individual patient's anatomy.

CLINICAL RELEVANCE/APPLICATION
Pre-procedural assessment of the PV ovality index might serve to guide the selection of an individualized ablation approach that maximizes the chances for therapeutic success.

CAS200

Determination of Myocardial Triglyceride Content in Patients with Fabry Disease: A 3T 1H-Magnetic Resonance Spectroscopy Study (Station #3)

Bernhard Petritsch (Presenter): Nothing to Disclose, Andreas Max Weng: Nothing to Disclose, Tobias Gassenmaier MD: Nothing to Disclose, Julian Donhauser MD: Nothing to Disclose, Christian Oliver Ritter MD: Nothing to Disclose, Meinrad Johannes Beer MD: Research Consultant, Shire plc, Herbert Koestler PhD: Research support, Siemens AG, Dietbert Hahn MD: Nothing to Disclose, Thorsten Alexander Bley MD: Nothing to Disclose, Michael Horn: Nothing to Disclose

PURPOSE
In Fabry disease progressive deposition of sphingolipids in different organs has been reported. High-field 1H-MR-spectroscopy (MRS) allows non-invasive determination of myocardial lipid content. This study investigates the role of myocardial steatosis in the complex pathomechanism of Fabry cardiomyopathy.

METHOD AND MATERIALS
In 30 patients (18 female, 12 male; 39 ± 13 years [range 17-61 years]) with genetically proven Fabry disease, myocardial triglycerides were quantified by 1H MRS (respiratory motion compensated, ECG triggered) in vivo using a 3 T scanner (Magnetom TRIO, Siemens Sector HealthCare, Germany). Single-voxel-spectroscopy was performed with and without water suppression. The voxel was positioned in the interventricular septum using a four-chamber and short-axis orientation at end systole to avoid signal contamination by epicardial fat. Two triglyceride peaks were measured (methylene groups at 1.3 ppm, methyl groups at 0.9 ppm) relative to the resonance from tissue water at 4.7 ppm. The myocardial lipid content was expressed as triglycerides-to-water ratio (%). In addition left ventricular (LV) mass and ejection fraction (EF) were assessed by MRI. 30 healthy volunteers without a history of cardiac or metabolic disease served as control group.

RESULTS
In all patients 1H spectra were successfully acquired. In Fabry patients the mean triglyceride-to-water ratio was 1.24% (min. 0.1%; max. 6.2%). The control group showed a significantly decreased lower (p=0.01) triglyceride-to-water ratio of 0.46% (min. 0.1%; max. 2.0%). Compared to healthy controls, LV mass (mean ± standard deviation; 127 ± 27 g) tended to be higher in Fabry patients (156 ± 66.5 g) (p<0.05). Mean EF was similar in both groups (65 % in Fabry patients vs. 63 % in controls).

CONCLUSION
High-field 1H-MR-spectroscopy using 3T scanners allows non-invasive assessment of myocardial lipid content in Fabry patients. In this patient collective we observed a significantly elevated myocardial triglyceride content. This finding warrants further studies with larger patient groups, especially concerning sub-group analysis of LE positive and negative Fabry patients.

CLINICAL RELEVANCE/APPLICATION
Besides data regarding functional and morphological alterations MRS delivers new insights into myocardial lipid metabolism in Fabry patients. This circumstance might help to further optimize the therapy for this rare disease.

CAS201

Does New Image Enhancement Technology Provide a Substantial Radiation Dose Reduction for Patients in Percutaneous Coronary Interventional Procedures? (Station #4)

Amber J. Giselson-Lee MSc (Presenter): Research funded, Koninklijke Philips NV, Claire Keeble MSc: Nothing to Disclose, Michael Lupton: Nothing to Disclose, David Barmby: Nothing to Disclose, Andrew Graham Davies MSc: Philips Healthcare, the Netherlands

PURPOSE
Recent releases of interventional X-ray equipment have seen innovations in image processing employed by manufacturers to reduce patient dose in applications such as vascular imaging. Philips' ClarityIQ combines anatomy-specific X-ray optimization with real-time image noise reduction algorithms to reduce patient dose in interventional cardiac imaging. A Clarity system was recently installed in our local cardiac catheterization laboratories; the aim of this study was to investigate whether the Clarity system reduced patient procedure dose (yet not increase procedure duration) in percutaneous coronary interventions (PCI).

METHOD AND MATERIALS
Previously collected patient dose data from the cardiac catheterisation labs was analysed by a statistician; sample size calculations showed that a minimum of 100 patients from each of two labs would be required for comparison. Patient procedure details were recorded for 130 PCI patients from the Clarity lab and 140 PCI patients from the Philips Xper (previous generation) lab in the same cardiology department. The Wilcoxon comparison. Patient procedure details were recorded for 130 PCI patients from the Clarity lab and 140 PCI patients from the Philips Xper (previous generation) lab in the same cardiology department. The Wilcoxon comparison.
patients from a Philips Xper (previous generation) lab in the same cardiology department. The Wilcoxon statistical test, which does not require equal numbers in each group, was used to compare median values from the two interventional X-ray systems.

RESULTS

The medians of total patient procedure dose were 2181 and 6060 cGy cm² from the Clarity and Xper systems respectively. Clarity median total patient doses were 1354 cGy cm² from fluoroscopy and 827 cGy cm² from digital image acquisition. Xper median total patient doses were 2734 cGy cm² from fluoroscopy and 3327 cGy cm² from acquisition. The Wilcoxon test showed strong statistical significance in these differences in total patient dose, at the 5% significance level (p << 0.001 in all cases). The median total fluoroscopy time [min:sec] was 12:39 for the Clarity system and 11:47 for the Xper system.

CONCLUSION

The total patient procedure dose for PCI patients was 64% lower in the Clarity cardiac catheterization lab than the Xper lab. Corresponding differences in total digital image acquisition and fluoroscopy doses were 50% and 75%. There was no statistically significant difference in total fluoroscopy time between the two labs.

CLINICAL RELEVANCE/APPLICATION

Substantial radiation dose savings can be realised for high dose cardiac interventional procedures by using state of the art X-ray equipment with innovative image processing; routine patient procedure data was used.

CAS202

Detection of Coronary Artery Anomaly in Patients with Complex Congenital Heart Disease by Dual-source CT (Station #5)

Zhaoping Cheng MD (Presenter): Nothing to Disclose, Ximing Wang PhD: Nothing to Disclose

PURPOSE

To explore the clinical usefulness of coronary artery anomaly (CAA) in patients with complex congenital heart disease (CHD) by low-dose dual-source CT (DSCT) angiography.

METHOD AND MATERIALS

We reviewed 615 consecutive patients with complex CHD who underwent DSCT angiography (CTA) from 2008 to 2012. According to the ultrasonic results, a total of 312 patients (age range 0.9-33yrs; male 170) with tetralogy of Fallot or double outlet right ventricle or pulmonary artery atresia were retrospectively included. Scans were divided by acquisition mode into 3 groups: retrospective electrocardiogram (ECG)-triggered spiral, prospective ECG-triggered, and prospective ECG-triggered high-pitch spiral scans. The subjective image quality was evaluated on a four-point scale by two radiologists. Radiation dose values were calculated. Interobserver agreement in subjective image quality grading was assessed by using kappa statistics. The scan groups were compared with the use of the Kruskal-Wallis test. A P value < 0.05 was considered statistically significant.

RESULTS

The incidence of CAA was 8%(25/312). CAA was involved in 8%(14/176)patients with tetralogy of Fallot, 8.3%(6/72)patients with double outlet right ventricle, 7.8%(5/64)patients with pulmonary artery atresia. Thirty of 312 studies were nondiagnostic (9.6%). In 76%(19/25)of the patients, the anomalous vessels were crossing the right ventricular outflow tract (RVOT). The average subjective image quality score was 2.9±0.9 (1-4). The score in high-pitch group was significantly lower than that in another two groups. Two radiologists made good agreement (k=0.72). Retrospective ECG-triggered scans had a median dose of 1.45 mSv, prospectively ECG-triggered scans had a median dose of 0.69 mSv, and prospectively ECG-triggered high-pitch spiral scans had a median effective dose of 0.35 mSv. The difference between groups was statistically significant (P

CONCLUSION

DSCT angiography is a reliable diagnostic method for the assessment of CAA with complex CHD; in contrast, low-dose prospectively ECG-triggered DSCT scans are the best choice.

CLINICAL RELEVANCE/APPLICATION

The course and origin of coronary arteries can be reliably assessed in children by using DSCT angiography imaging to shorten or avoid invasive coronary artery imaging in the catheterization laboratory.

CAS203

Influence of Cardiac Motion on Stent Visualization in Third Generation Dual-source CT: In Vitro Evaluation of 13 Coronary Stents in a Pulsatting Phantom Heart Model (Station #6)


PURPOSE

To evaluate the influence of cardiac motion during coronary CT angiography on coronary stent visualization in a third generation dual-source CT scanner.

METHOD AND MATERIALS

13 coronary stents (diameter 3.0 mm) were implanted in plastic tubes filled with contrast (density 350 HU) and
Magnetic Resonance Imaging of the Papillary Muscles: Normal Anatomy, Variants and Abnormalities (Station #7)

Nicholas L. Fulton MD : Nothing to Disclose, Prabhakar Rajiah MD, FRCR (Presenter): Institutional Research Grant, Koninklijke Philips NV

TEACHING POINTS

1. To understand the anatomy and variations of papillary muscles.
2. To discuss the role of MRI in the evaluation of papillary muscle abnormalities.
3. To illustrate the several abnormalities that is seen in papillary muscles.
4. To understand the significance of papillary muscle anatomy in hypertrophic cardiomyopathy, LV partitioning device placement, etc.

TABLE OF CONTENTS/OUTLINE

- Papillary muscle anatomy - vascular supply
- Anatomical variants of papillary muscle - Accessory muscles
- Role of CT/MRI in evaluation (Cine imaging, delayed enhancement, tagging, perfusion)
- Description and illustration of the following abnormalities: Parachute mitral valve, parachute like asymmetric mitral valve
- Shone complex Hypertrophic cardiomyopathy LVOT obstruction by papillary muscle Anomalous insertion, apical displacement, Hypermobile muscle Papillary muscle dysfunction
- Infarction Rupture Mitral incompetence due to papillary abnormalities Calcification Benign Neoplastic masses - Fibroelastoma, myxoma, rhabdomyoma
- Malignant neoplastic masses - Metastases, sarcoma, lymphoma
- Non neoplastic masses - Thrombus Accessory muscle mimicking thrombus
- Anatomy for LV partitioning device.

Surgical Management of Anomalous Origin of Coronary Artery from the Opposite Sinus: What Every Surgeon Should Know before Operating on a Coronary Anomaly—The Role of Cardiac Radiologist (Station #8)

Marta Tomas Mallebrera MD (Presenter): Nothing to Disclose, Angeles Franco Lopez: Nothing to Disclose, Gonzalo Aldamiz-Echevarria: Nothing to Disclose, Miguel Orejas Orejas: Nothing to Disclose

TEACHING POINTS

Patients with a coronary artery arising from the wrong sinus are susceptible to ischemia and sudden death. Surgical correction is indicated in all patients with coronary insufficiency and in asymptomatic patients with high-risk morphologic abnormalities. ECG-gated multidetector row computed tomography is superior to conventional angiography in delineating the ostial origin and proximal path of an anomalous coronary artery and detects atherosclerotic disease coexisting with the anomaly. The purpose of this exhibit is: -to describe the diagnostic clues to detect the anomalies of high-risk: interarterial course, intramural course, silt-like ostium and angulation abnormalities and severe atherosclerotic disease coexisting with the anomaly. -to provide a morphology-based surgical management protocol.

TABLE OF CONTENTS/OUTLINE

1. Classification of the course of anomalous coronary artery arising from wrong sinus.
2. Diagnostic clues to detect the anomalies of high risk: interarterial course, intramural course, silt-like ostium and angulation abnormalities and severe atherosclerotic disease coexisting with the anomaly.
3. Surgical procedures including coronary artery reimplantation, pulmonary translocation, bypass grafting, unroofing and fenestration, and.
TEACHING POINTS

The purpose of this exhibit is to review imaging considerations for cardiac/thoracic MRI in patients with implanted cardiac devices. The safety of cardiac/thoracic MRI in these patients, absolute contraindications, and techniques to improve image quality will be covered through a review of the relevant literature and the experience at our institution.

TABLE OF CONTENTS/OUTLINE

There is an increasing volume of information in the literature touting the safety of cardiac/thoracic MRI in patients with implanted cardiac devices. Although several FDA approved devices have been designated MR conditional, none of these are approved for imaging with the device in the isocenter of the magnet. Despite this, cardiac/thoracic MRI studies are being safely performed in many academic centers. This educational exhibit will cover three important aspects of cardiac/thoracic MRI in patients with implanted cardiac devices. First, the safety of imaging patients with these devices will be discussed with a review of the relevant radiology literature. Absolute and relative contraindications to cardiac/thoracic MRI in these patients will then be discussed. Techniques to improve image quality on these exams will be covered with a discussion of SAR considerations. Finally, we will review our institution's protocol for performing cardiac MRI/thoracic MRI.

CHS-TUA

Chest Tuesday Poster Discussions

Scientific Posters

CHS-TUA

AMA PRA Category 1 Credits ™ : .50
Tue, Dec 2 12:15 PM - 12:45 PM  Location: CH Community, Learning Center

Participants

Moderator
Hiroto Hatabu, MD, PhD:
Research Grant, Toshiba Corporation Research Grant, AZE, Ltd Research Grant, Canon Inc

Sub-Events

CHS252

Diffuse Peribronchovascular Opacities on CT: Profiling and Pathological Backgrounds of this Unique Finding (Station #1)

Takeshi Johkoh MD, PhD (Presenter): Research Consultant, Bayer AG Research Consultant, F. Hoffman-La Roche Ltd, Kiminori Fujiimoto MD, PhD: Nothing to Disclose, Hiroaki Arakawa MD: Nothing to Disclose, Tomonori Tanaka MD: Nothing to Disclose, Junya Fukuoka: Nothing to Disclose, Noriyuki Tomiyama MD, PhD: Nothing to Disclose

PURPOSE

Diffuse peribronchovascular opacities on CT, also called "twitter sign" were defined as areas with ground-glass attenuation or airspace consolidation which diffusely distribute along relatively central bronchus and pulmonary arteries on CT (Fig). Although various diseases share this abnormality, disease spectrum, frequency, and pathological backgrounds have still unclear. The purpose of the study was to profile the diseases which show this unique finding and to demonstrate its pathological backgrounds

METHOD AND MATERIALS

From 2008 to 2012, at four institutes, 42 patients showed diffuse peribronchovascular opacities on CT. Clinical diagnosis, clinical course and prognosis were abstracted from each hospital record. The patients ranged from 28 to 70 years of age (mean42), and included 22 males and 20 females. Two observers independently evaluated CT findings. Three cases were done surgical lung biopsy and two cases were done autopsy. In these five cases, precise radiologic pathologic correlation was done.

RESULTS

Clinical diagnosis include 17 drug induced pneumonitis (40%), 10 collagen vascular disease (24%), seven cryptogenic organizing pneumonia (17%), three non-specific interstitial pneumonia (7%), two acute respiratory distress syndrome (ARDS) (5%), two acute interstitial pneumonia (5%), and one pneumocystis pneumonia (2%). Ten cases (24%) showed acute process, 27 (48%) showed subacute one, and remaining five (12%) showed chronic one. Forty cases (95%) showed good response to treatment and recovered. In two autopsy cases, peribronchovascular opacities corresponded to organization, fibrosis, and cellular infiltration along central bronchus and pulmonary arteries. In all cases with autopsy and surgical biopsy, pathological diagnosis was organizing pneumonia supervening with fibrosis.

CONCLUSION

Although the diseases with diffuse peribronchovascular opacities are rare, they seem to share common clinical and pathological findings such as subacute or acute onset, good prognosis, and organizing pneumonia with fibrosis. A new disease entity may be defined by using imaging method.

CLINICAL RELEVANCE/APPLICATION
Diseases with diffuse peribronchovascular opacities on CT share common clinical and pathological findings such as subacute or acute onset, good prognosis, and organizing pneumonia with fibrosis.

**CHS253**

**Assessment of Efficacy of Automatic 2D-fusion Module to Identify Unknown Body using Forensic Imaging—Comparison of Ante-mortem Chest X-ray and Post-mortem Chest CT (Station #2)**

Norihiro Shinkawa MD (Presenter): Nothing to Disclose, Ryuichi Nishii MD, PhD: Nothing to Disclose, Hiroki Tamura: Nothing to Disclose, Ichijo Hodaka: Nothing to Disclose, Nobuhiro Yukawa: Nothing to Disclose, Shigeki Nagamachi MD, PhD: Nothing to Disclose.

**PURPOSE**

Identification of unknown deceased body has been performed mainly based on DNA profiling, fingerprinting or dental X-ray, however preparation of referred ante-mortem samples under controlled condition are complicated. Recently, post-mortem whole body CT has been widely used. And chest X-ray is also widely available not only for chest diseases but also for medical checkup. The purpose of this study is to develop novel method for identification unknown body using forensic imaging. As the initial examination, we assess the concordance between post-mortem chest CT and ante-mortem chest X-ray.

**METHOD AND MATERIALS**

Among 82 subjects performed post-mortem CT in our institute from April 2010 to February 2014, 15 subjects (11 male and 4 female, 65±19 years) who underwent chest X-ray (as an ante-mortem imaging) more than 1 year ago were enrolled in this investigation. To compare chest coronal CT focused on the soft tissue attenuation and chest X-ray among same person and others, total of 225 tests were performed using automatic 2D-fusion module of the image analysis workstation Vincent (Fujifilm Medical System, Japan).

**RESULTS**

For the automatic 2D-fusion module, anatomical landmarks were placed in both apex and sub-carina (3-point method), or both medial margin of the thorax at the horizontal level of the sub-carina in addition to above 3 point(5-point method). Each CT was superimposed on X-ray using 3-point or 5-point method. Distance score of the portion gap of landmark (mm) between post-mortem CT and ante-mortem X-ray was assessed using the module in the workstation. In the 3-point method, when employing same person’s CT and X-ray, mean distance score of position gap were 4.13±2.99, in contrast 5.61±3.08 when employing those images of different person (P=0.06). In the 5-point method, when employing those images of the same person, mean distance score of position gap were 4.70±2.97, in contrast 6.77±2.73 when employing those images of different person (P<0.01).

**CONCLUSION**

To identify the unknown deceased body, post-mortem CT was considered to be useful by comparing with ante-mortem chest X-ray. Using 5-point method, automatic 2D-fusion module of the Vincent workstation was useful tool to identification of post-mortem CT.

**CLINICAL RELEVANCE/APPLICATION**

This novel imaging analysis method is promising to develop newly-proposed computer assisted diagnostic imaging for swift and precise identification of unknown deceased body.

**CHS254**

**Pulmonary Fibrosis in ANCA-associated Vasculitis: Radiologic Patterns at Diagnosis and Follow-up (Station #3)**

Anne Laure Brun MD (Presenter): Nothing to Disclose, Cloë Comarmond: Nothing to Disclose, David Saadoun: Nothing to Disclose, Philippe A. Grenier MD: Nothing to Disclose.

**PURPOSE**

Pulmonary fibrosis (PF) is a rare but therapeutically challenging manifestation observed in patients with ANCA-associated vasculitis (AAV), particularly microscopic polyangiitis (MPA). The aim of the current study was to describe imaging patterns and evolution of PF in a large multicentric series of 42 patients with AAV.

**METHOD AND MATERIALS**

This retrospective study is based on 42 patients with AAV (fourty MPA, two granulomatosis with polyangiitis) and PF diagnosed and followed up in 16 medical centers, between January 1996 and June 2013. Two radiologists blinded to the clinical and histopathological data, reviewed initial chest computed tomographic (HRCT) scans to establish the type [usual interstitial pneumonia (UIP), non specific interstitial pneumonia (NSIP), combined pulmonary fibrosis-emphysema (CPFE)], and severity of PF. Patterns and coarseness evolution were also studied in 30/42 patients with a median follow-up of 30 months.

**RESULTS**

The initial HRCT pattern included typical UIP (n=18, 43%), atypical UIP (n=6, 14%), fibrotic NSIP (n=3, 7%), CPFE (n=9, 21.4%), NSIP (n=4, 9.5%) and undetermined patterns in 2 patients (4.8%). Patients with NSIP and fibrotic NSIP had a lower coarseness score compared to patients with CPFE, atypical or typical UIP (median coarseness score of 3.25 [0-5] and 6 [4-10] versus 8 [4-15], 9 [4-12] and 10 [3-15], respectively.)
After a median follow-up of 30 [2-75] months, PF had progressed in 22/30 (73%) patients and was stable in 8 patients (27%). The severity of PF based on extension and/or coarseness scores had worsened for all but one UIP, all but one NSIP, and two on six CPFE. Three on four atypical UIP and one on two fibrotic NSIP had turned into typical UIP patterns.

**CONCLUSION**

UIP is the main pattern associated with AAV but other initial patterns may be encountered at diagnosis, including NSIP and CPFE. Thus, AAV should be part of the etiologic investigation of all patients presenting with NSIP, CPFE or UIP patterns.

**CLINICAL RELEVANCE/APPLICATION**

UIP is the main pattern of PF in patients presenting with AAV and PF, but other patterns may be encountered at diagnosis, including NSIP and CPFE.

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**CHS255**

**Pain Perception in Patients Undergoing CT Guided Lung Biopsies (Station #4)**

Zonia Ghumman (Presenter): Research support, Toshiba Corporation; Hassan Shoushtari MD: Nothing to Disclose; Ravi Menezes PhD: Nothing to Disclose; Demetris Andrea Patsios MBCh: Nothing to Disclose; Yasser Karimzad BSc: Nothing to Disclose; Narinder S. Paul MD: Research funded, Toshiba Corporation

**PURPOSE**

To identify patients at increased risk for pain related to CT guided fine needle aspiration biopsy (CT-FNAB) of the lung.

**METHOD AND MATERIALS**

IRB approved prospective recruitment of patients referred for CT-FNAB from February-May 2013. Patients completed 3 questionnaires: 30 minutes prior to CT-FNAB (Q1), 30 minutes post CT-FNAB (Q2) and ≤72 hours post CT-FNAB (Q3). The validated Brief Pain Inventory (BPI) was included to assess how pain interfered in the patients’ daily activities and was rated based on pain severity (PS) and pain interference (PI). The BPI used numerical rating scales from 0 (no pain/interference) to 10 (severe pain/interference). The radiologist documented use of IV analgesia (fentanyl 50-100mcg) and sedation (midazolam 1-2mg) during CT-FNAB (Q4).

**RESULTS**

The study cohort included 50 patients (29 males, 21 females), with a mean age of 65.2 years ([40, 83], SD 9.5). BPI scores [mean (range)] showed PS and PI scores pre-procedure = 1.14 (0-6.8) and 0.93 (0-7.3), and 48-72 hours post-procedure = 1.05 (0-6.3) and 0.58 (0-6.7) respectively. Most patients had low mean PS and PI scores pre- and post-procedure. A subset of 9/50 patients (18%) had chronic discomfort from pre-existing conditions and scored the highest in both domains. Mean PS and PI domains pre-procedure for this population were 3.69 (1.5-6.8) and 3.78 (0-7.3), while mean PS and PI domains post-procedure were 3.33 (0-6.3) and 2.14 (0-6.7). Patients in the prone position (36/50, 72%) experienced significantly more discomfort than patients in the supine position (p=0.013, Mann-Whitney test). Additional IV analgesia and sedation was only required in 5 patients (10%) all of whom were prone during CT-FNAB.

**CONCLUSION**

Patients with pre-existing painful conditions and those who require prone positioning during CT-FNAB are at higher risk for procedure related pain. Patients with co-morbid painful conditions can be identified pre-procedure using a short, validated pain score and provided with individualized pain management. Patients that need to be prone during CT-FNAB can be positioned strategically with extra cushioning and given increased analgesia for improved pain management.

**CLINICAL RELEVANCE/APPLICATION**

Pain is a side effect of CT-FNAB that can be minimized if modifiable risk factors like patient positioning and analgesic control are identified correctly and adjusted accordingly.
Sub-Events

ERS221  Differentiation of Uric Acid and Non-uric-Acid Kidney Stones Using a Single-source 64 Slice CT Scanner: Initial Clinical Experience (Station #1)

Xiaohu Li (Presenter): Nothing to Disclose, Bing Liu MD: Nothing to Disclose, Yu Yongqiang MD, PhD: Nothing to Disclose

PURPOSE

To prospectively assess the accuracy of Single x-ray Single-source 64 slice CT Scanner technique that uses two consecutive scans for differentiating uric acid (UA) and non-uric-acid (No-UA) Kidney stones

METHOD AND MATERIALS

52 patients (24 males and 28 females) undergoing clinically-indicated dual energy spectral CT (DESCT, fast kilovoltage switching) to differentiate UA and No-UA Kidney stones were enrolled in this IRB-approved study. Immediately following the DESCT scan, each patient was scanned on a single-source 64 slice CT scanner (SS) with two consecutive scans (80 and 140 kVp) over a scan range limited to where stones had been identified using DESCT. UA and No-UA stones were differentiated using Advantage Workstation 4.5 (GE Healthcare, Milwaukee, WI, USA). The accuracy of stone classification for stones >1.5mm in diameter was calculated using the results from the DESCT scanner as the reference standard.

RESULTS

A total of 364 stones were identified in DS exams (32 UA and 332 No-UA). Average stone diameter was 4.1 ± 1.4 mm (range 1.5 to 15.6 mm). Among these stones, SS exams detected 82 UA and 282 No-UA stones. Overall sensitivity and specificity for identifying UA stones were 67% and 85%. For stones >4 mm (37 UA and 235 No-UA on SS exams, 26 UA and 266 No-UA on DESCT exams), sensitivity and specificity were 93% and 96%. Image quality of the SS exam was similar to or slightly better than that of the DESCT exam.

CONCLUSION

Differentiation of UA and No-UA Kidney stones is feasible by using two consecutive scans. UA stones could be identified using a SS CT scanner with an accuracy of 96% for stone sizes >4mm.

CLINICAL RELEVANCE/APPLICATION

Knowledge of the composition of urinary tract stones is a fundamental part of the preoperative patient evaluation, and this information influences treatment plans and recurrence prevention. UA stones may be treated with urinary alkalization as a first-line treatment, with surgical treatment being reserved for stones that do not respond to medical therapy. Accurate Differentiation of UA and No-UA using SS scanners may increase availability for this technique, which is clinically useful in identifying patients with medically treatable stones.

ERS222  Utility of iPAD as a Diagnostic Console for Detecting Acute Appendicitis on Focused Appendiceal Computed Tomography (Station #2)

Muhammad Awais MBBS (Presenter): Nothing to Disclose, Dawar Burhan Khan FRCR, MBBS: Nothing to Disclose, Danish Barakzai MBBS: Nothing to Disclose, Abdul Rehman MBBS: Nothing to Disclose, Naila Nadeem: Nothing to Disclose

PURPOSE

Acute appendicitis is a surgical emergency and accurate timely diagnosis is crucial for improving outcomes. Focused appendiceal computed tomography (FACT) has become one of the primary diagnostic modalities for acute appendicitis. Portable gadgets (like tablets, laptops and smart-phones) have the potential to greatly improve communication between radiologists and surgeons. iPAD, although being small, has sufficiently large display with a long battery life, enabling it to be used as a portable diagnostic imaging console. In the present study, we compared the accuracy of iPAD as a diagnostic console for diagnosing acute appendicitis on FACT using Picture Archival and Communication System (PACS) workstation as reference standard.

METHOD AND MATERIALS

Two hundred and twenty five (225) patient underwent FACT at our institution from January, 2012 to June, 2013. All these CT scans were blindly re-interpreted by an independent consultant radiologist first on iPAD version 2.0 and two weeks later, on PACS diagnostic workstation. CT scans were interpreted for the presence of acute appendicitis, location of appendix, phlegmon formation, perforation, appendicolith, free fluid and maximal appendiceal transverse diameter (outer wall to outer wall). Statistical analysis was performed on SPSS version 20. Paired student t-test and kappa statistics were used for comparison. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Ninety nine (99) out of 225 patients had radiological evidence of acute appendicitis on PACS workstation. iPAD was 100% accurate in diagnosing acute appendicitis using PACS workstation as the reference standard. Appendicoliths were identified on PACS workstation in 43, phlegmon in 10, free fluid in 39 and perforation in 12 of the CT scans. Kappa (κ) statistics showed excellent agreement between iPAD and PACS workstation for the detection of appendicolith (κ = 0.945), phlegmon (κ = 0.817), free fluid (κ = 0.793) and perforation (κ = 0.904).
Student’s t-test failed to reveal any significant difference (p=0.222) between the mean appendiceal transverse diameter as measured on iPAD (11.511 mm) versus PACS workstation (11.288 mm).

CONCLUSION
iPAD, as a diagnostic console, was as accurate as PACS workstation for the diagnosis of acute appendicitis on FACT.

CLINICAL RELEVANCE/APPLICATION
iPAD may be used as an efficient portable imaging console for diagnosing acute appendicitis on FACT.

First-line Ultrasound in the Work-up of Acute Appendicitis at an Academic Teaching Hospital with 24/7 Radiology (Station #3)

David Tso MD (Presenter): Nothing to Disclose, Jennifer Wang BS: Nothing to Disclose, Patrick McLaughlin FFR(RCSI): Nothing to Disclose, Douglas S. Katz MD: Nothing to Disclose, Silvia D. Chang MD: Nothing to Disclose, Savvas Nicolaou MD: Nothing to Disclose

PURPOSE
This study evaluated the role of ultrasound as a first-line imaging modality for the work-up of acute appendicitis in young adults at an academic teaching hospital with 24/7 staff radiologist on site. This study attempted to determine the specificity and sensitivity of ultrasound in diagnosing appendicitis and the need for further imaging.

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 investigated with ultrasound as first-line imaging were identified. Scan time, findings on ultrasound, and the need for further imaging was documented. 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. Average time for a scan was 28.6 minutes. The appendix was visualized in 28.3% on ultrasound and was equivocal on 11.3%. Of the 30 cases where the appendix was visualized, 76.7% were sonographically diagnostic for acute appendicitis and had an average appendiceal diameter of 10mm. An alternative diagnosis was found in 16% of all cases, with ovarian pathologies being most common. Of the 23 confirmed cases of appendicitis on ultrasound, only 2 patients required further imaging. 18 patients went to the operating room where appendicitis was confirmed on all but one case. Perforation rate was 35.3%. Of the 83 patients with negative or equivocal ultrasound scans, 47.0% required further imaging (64.1% CT, 35.9% MRI). The appendix was seen on all CT scans, but on only 78.7% of all MRI scans. 12 patients went to the operating room where all cases were diagnosed with appendicitis with a perforation rate of 41.7%. The sensitivity and specificity of ultrasound was 70.8% and 92.9% respectively.

CONCLUSION
First-line ultrasound is utilized in young patients to avoid exposure to radiation. The appendix is not visualized a majority of the time on ultrasound, necessitating further imaging. When the appendix is visualized, ultrasound demonstrates high specificity for the diagnosis of acute appendicitis.

CLINICAL RELEVANCE/APPLICATION
Ultrasound is a useful first-line imaging modality for the diagnosis of appendicitis when the appendix can be visualized.

Fluoroscopy-Guided Treatment of Acute Esophageal Food Impactions in the Emergent Setting (Station #5)

Wenjia Wang MD (Presenter): Nothing to Disclose, Michael J. Shortsleeve MD: Nothing to Disclose

PURPOSE
Our department utilizes a combination therapy of intravenous glucagon, effervescent crystals, and water to treat acute esophageal food impactions in the emergent setting. We present our results from 109 consecutive completed procedures performed from 2002 to 2013.

METHOD AND MATERIALS
Patients with acute food impactions (less than 24 hours duration) in the esophagus were selected. Single contrast esophagrams were performed with 5 ml of undiluted non-ionic water-soluble contrast to confirm the presence and location of food impactions. Patients were then administered 1 ml of IV glucagon, one packet of E-Z Gas, and 240 ml of water. A second single-contrast esophagram was obtained to evaluate food bolus clearance and to exclude perforation. From 2002 to 2013, we performed 130 consecutive procedures, of which 21 were excluded for premature abortion due to patient vomiting.

RESULTS
The therapy resulted in 57 successful (excluding 3 which resolved within 30 minutes later in the emergency
Diaphragmatic Disruption: A Frequently Missed Injury after Blunt Thoraco-abdominal Trauma; Lessons from a Level I Trauma Center (Station #4)

Justing Wayne Skweres MD : Nothing to Disclose, Arielle Dubose MD : Nothing to Disclose, Guillermo P. Sangster MD (Presenter): Nothing to Disclose, John Robinson MS : Nothing to Disclose, Jason Brownell : Nothing to Disclose

TEACHING POINTS
1. Illustrate Multidetector Computed Tomography (MDCT) findings of diaphragmatic injury (DI) after blunt thoraco-abdominal trauma. 2. Depict direct and indirect signs of DI. 3. Discuss false positive findings that may be misinterpreted as DI at MDCT.

TABLE OF CONTENTS/OUTLINE
MDCT is the imaging modality of choice for evaluation of hemodynamically stable patients with blunt trauma. DI is an uncommon but serious condition, and often unrecognized. A collective of patients with diaphragmatic rupture or detachment after blunt trauma encountered in clinical practice trauma center form the basis of this pictorial essay. Direct and indirect signs of DI are discussed: 1. Diaphragm discontinuity. 2. Intrathoracic herniation of abdominal contents. 3. Constriction of the herniated abdominal viscera: “collar sign”. 4. Visualization of the herniated viscera against the posterior chest wall: “dependent viscera sign”. 5. The delayed diaphragmatic rupture process is reviewed. 6. Mimics of DI: congenital diaphragmatic defects (Bochdalek and Morgagni), eventration and hiatal hernias. This educational exhibit substantiates the benefits of multiplanar MDCT in the detection and pre-operative planning in trauma pts sustaining DI. Subtle signs should be recognized for timely diagnosis, and familiarity with potential mimics is key to avoid unnecessary procedures.

Imaging of Cranio-Cervical Junction Traumatic Injuries: What the Clinician Needs to Know (Station #6)

Roy Riascos MD (Presenter): Nothing to Disclose, Eliana E. Bonfante MD : Nothing to Disclose, Claudia Cotes MD : Nothing to Disclose, Reza Hakimela MD : Nothing to Disclose

TEACHING POINTS
Review the anatomy and different structures that stabilize the cranio-cervical junction. Analyze the different types of traumatic injuries that occur in the cranio-cervical junction. Understand the mechanical forces involved in cranio-cervical stability. Review the current classifications of cranio-cervical trauma and their imaging findings. Identify how imaging plays a role in the prognosis and treatment of cranio-cervical junction injuries.

TABLE OF CONTENTS/OUTLINE
1. Introduction 2. Indications of Imaging • Plain films • CT • MRI 3. Cranio-Cervical Junction Anatomy • Bony Anatomy • Ligamentous Anatomy • Craniometry 4. Traumatic Injuries of the Cranio-Cervical Junction • Atlanto-Occipital Dislocation • Atlanto-Occipital Fractures • Fractures of the Atlas and Transverse Ligament Rupture • Atlanto-Axial Rotatory Deformity • Odontoid Fractures • Traumatic Spondylolisthesis of the Axis 5. Conclusion/Summary • What the clinician needs to know

Broken Bones, Bleeding Vessels, and Leaking Bladders: A Comprehensive Review of Acute Pelvic Trauma (hardcopy backboard)


TEACHING POINTS
Review osseous, vascular, and genitourinary (bladder and urethral) injuries that occur in acute pelvic trauma. Describe imaging tests such as MDCT, CT cystogram, and retrograde urethrogram used in the evaluation of pelvic traumatic injuries. Review classification of pelvic fractures and bladder and urethral injuries and implications for clinical management. Discuss the critical role of interventional radiology.
Acute pelvic trauma can result in pelvic fractures and soft tissue injuries due to high-energy mechanisms. Imaging plays an important role in identifying injuries that can be life-threatening and may need to be managed by a multidisciplinary team. A 10-year search of the radiology information system for pelvic trauma yielded 900 cases that were reviewed for this exhibit. In this exhibit, pelvic ring fractures, vascular injuries, and bladder and urethral injuries are reviewed including mechanism of injury, imaging appearance and implications for management. The most appropriate imaging tests are discussed including CT cystogram and retrograde urethrogram. The role of interventional radiology in the management of acute pelvic trauma is discussed. After reviewing this exhibit, a radiologist will have a global and in-depth understanding of acute pelvic trauma and the myriad of injuries that can be sustained.

**GIS-TUA**

**Gastrointestinal Tuesday Poster Discussions**

**Scientific Posters**

**CT Perfusion Based Visualization and Quantification of Pancreatic Carcinoma Using 256 Slice CT**

**Feasibility on Predicting the Response in Combined Chemoradiotherapy or Chemotherapy (Station #1)**

Yukiko Kunou (Presenter): Nothing to Disclose, Masafumi Uchida MD, PhD: Nothing to Disclose, Hayato Kaida: Nothing to Disclose, Yasumitsu Hirose: Nothing to Disclose, Hidehiro Etou: Nothing to Disclose, Yoshinobu Okabe: Nothing to Disclose, Toshi Abe MD: Nothing to Disclose

**Purpose**

to evaluate the utility of pancreatic perfusion CT for predicting the response of pancreatic carcinoma to combined chemotherapy and radiotherapy or chemotherapy.

**Method and Materials**

From July 2009 to November 2012, we enrolled 43 patients (26 men, 17 women: mean age 67 years, range 37-81 years) with unresectable pancreatic carcinoma who underwent PPCT before receiving CCRT or chemotherapy. Four perfusion parameters (perfusion, peak enhancement intensity, time to peak, and blood volume) of pancreatic tumor were calculated and we divided each perfusion parameter into two groups: high value group and low value group. The CCRT response was evaluated morphologically on 3-month follow-up CT based on the Response Evaluation Criteria in Solid Tumors. Pretreatment CT perfusion parameters were compared between responders and nonresponders by the Fisher exact test. Overall survival of the two groups was estimated by using the Kaplan-Meier method and compared by using the log-rank test.

**Results**

Based on RECIST criteria, 13 of the total 43 patients had partial response (PR) at 3 months post-initiation of therapy, 24 had stable disease (SD) and six had progressive disease (PD). There was a statistically significant difference in all perfusion parameters when patients with PR at three months were compared with patients with SD or PD: perfusion: P< .01, peak enhancement intensity: P< .05, time to peak: P < .01, and blood volume: P< .01. Of the 43 patients, four were lost to follow-up and were excluded from survival analysis. Of the remaining 39 patients, 13 were alive at a mean of 19 (range, 8 to 44) months after beginning therapy and 26 had died. Six of the 43 patients underwent surgical resection after neoadjuvant therapy, five of whom received CCRT and one received only chemotherapy. Of the four perfusion parameters measured, only the high value group of the peak enhancement intensity was significantly correlated with a higher likelihood of survival at 15 months post-initiation of therapy (p=0.01).

**Conclusion**

Prediction of therapeutic effects is useful in management of patients with pancreatic carcinoma. Although conventional CT relies on many morphological findings, evaluation of pancreatic tumor perfusion with CT can provide radiologists and clinicians with very useful information that can be applied directly to patient care.

**Clinical Relevance/Application**

Pancreatic perfusion CT

**GIS353**

The Relationships between Signal Changes with Time in the Hepatobiliary Phase of Gd-EOB-DTPA Enhanced MR Imaging and the Degree of Histopathologic Grades in Hepatocellular Carcinomas (Station #2)

Atsushi Higaki MD (Presenter): Nothing to Disclose, Tsutomu Tamada MD, PhD: Nothing to Disclose, Teruki Sone MD, PhD: Nothing to Disclose, Akira Yamamoto MD: Nothing to Disclose, Yasufumi Noda: Nothing to Disclose
PURPOSE
The purpose of this study was to evaluate the relationships between signal intensity in the three hepatobiliary phases (10, 15, 20 minutes) of Gd-EOB-DTPA enhanced MR imaging and the degree of histopathologic grades in hepatocellular carcinoma (HCC).

METHOD AND MATERIALS
A retrospective analysis of 64 HCCs (well-differentiated, n = 15; moderately, n = 36; poorly, n = 13) in 60 patients who underwent preoperative Gd-EOB-DTPA-enhanced MRI was performed. Hepatobiliary phase (HP) images were obtained at 3 times (10, 15, 20 minutes) after Gd-EOB-DTPA administration. Signal intensity of the lesion in all phases was measured using region-of-interest for the calculation of contrast enhancement ratio (CER). A two-factor repeated-measures analysis of variance (ANOVA) model was used for statistical analysis.

RESULTS
The mean CER was 36.8 (range, 17.1 to 68.9) at 10 minutes, 42.8 (range, 20 to 88.5) at 15 minutes and 48.1 (range, 21.6 to 95.8) at 20 minutes in the well-differentiated HCC (w-HCC), 36.7 (range, 15.7 to 68.2), 32.04 (range, 9.3 to 47.3) and 29.49 (range, 7.6 to 51.6), respectively, in the moderately differentiated HCC (m-HCC) and 30.4 (range, 10.8 to 53.8), 25.89 (range, 8.7 to 44.8) and 19.93 (range, 5.3 to 37.2), respectively, in the poorly differentiated HCC (p-HCC). The results of a multiple comparison assuming time as a factor show that the CER of w-HCCs (P < 0.001) increased significantly with time until 20-min HP, whereas the CER of m-HCCs (P < 0.02-0.001) and p-HCCs (P < 0.01-0.001) showed significant decreases with time until 20-min HP. When degree of differentiation was assumed as a factor, the multiple comparison results showed that there were no significant differences among the 3 groups at 10 minutes, whereas there were significant differences between w-HCCs and m-HCCs at 15 minutes (P = 0.011), and between w-HCCs and m-HCCs, and w-HCCs and p-HCCs at 20 minutes (P < 0.001, P < 0.001, respectively).

CONCLUSION
In the hepatobiliary phase of Gd-EOB-DTPA enhanced MR imaging, the CER increased with time in w-HCCs, but decreased with time in both m-HCCs and p-HCCs, probably reflecting the difference in contrast enhancement behavior of the lesion.

CLINICAL RELEVANCE/APPLICATION
W-HCCs may be distinguished from m-HCCs/p-HCCs based on CER changes during the hepatobiliary phase.

GIS354

Computer-aided Assessment of Hepatic Contour Abnormalities as an Imaging Biomarker for the Prediction of Hepatocellular Carcinoma Development in Patients with Chronic Hepatitis C (Station #3)

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

PURPOSE
To evaluate whether hepatic fibrosis index (HFI) quantified on the basis of hepatic contour abnormality is a risk factor for the development of hepatocellular carcinoma (HCC) in patients with chronic hepatitis C.

METHOD AND MATERIALS
During a 14-month period, we prospectively evaluated 98 patients with chronic hepatitis C who had no medical history of HCC treatment (56 men and 42 women; mean age, 70.7 years; range, 48-91 years). Gadoxetic acid enhanced hepatocyte phase was used to detect and analyze hepatic contour abnormality. Hepatic contour abnormality was quantified and converted to HFI using in-house proto-type software. HFI was computed and compared between patients with (n = 54) and without HCC (n = 44), and tested as a risk factor for the development of HCC determined by the odds ratio with binominal logistic analysis.

RESULTS
HFI was significantly higher in patients with HCC (0.58+/-.086) than without HCC (0.36+-/0.11) (P < 0.001). Logistic analysis revealed that HFI was a significant risk factor for HCC with an odds ratio (95% confidence interval) of 26.4 (9.0-77.8) with a cutoff value of 0.395.

CONCLUSION
Hepatic fibrosis index, generated using a computer-aided assessment of hepatic contour abnormality, may be a significant imaging biomarker for the development of HCC in patients with chronic hepatitis C.

CLINICAL RELEVANCE/APPLICATION
A computer-generated, hepatic morphological index is highly predictive for the development of HCC in patients with chronic hepatitis C. This index may be an important imaging biomarker for clinical management of these patients.
Virtual Unenhanced CT Imaging with the Conventional Unenhanced CT Imaging in Liver: A Comparative Study (Station #5)

junjie mao (Presenter): Nothing to Disclose, Junlin Zhou: Nothing to Disclose

PURPOSE

To assess the advantages and disadvantages of virtual unenhanced (VU) CT imaging obtained by gemstone spectral imaging (GSI) to explore the feasibility of omitting the conventional unenhanced (CU) CT imaging in the dual phase enhanced CT in liver.

METHOD AND MATERIALS

23 patients underwent routine liver scan (120kVp, 300mAs, 64×0.625mm) and dual-phase enhanced scan with GSI mode on a 64-row dual energy CT (Discovery CT 750HD, GE healthcare). Virtual unenhanced images were generated by suppressing iodine on 70keV monochromatic image with a dedicated software (GSI Volume Viewer, Advantage Workstation 4.6). The CT value, SNR were measured and calculated. Referencing the clinical pathology and enhanced CT and ultrasound results, the lesion detection rate was got by two experienced radiologists independently. Dose-length product (DLP) was recorded and effective dose (ED) was calculated with a conversion factor 0.015mSv/mGy×cm. The CT value, SNR and ED were compared with paired student T-test, the lesion detection rate was compared with chi-square test.

RESULTS

The average CT value of VU images was slightly lower than that of CU images (54.54±7.71 vs 56.78±7.86, t=2.99, P=0.008). The SNR of VU images for was higher than that of CU images (5.38±0.75 vs 3.51±0.34, t=10.79, P<0.01). The lesion detection rates of VU images and CU images had no significant difference (66.59% vs 68.32%, X2=0.25, P>0.05). The ED for dual enhanced phases was (12.43±7.47) mSv, lower than that of true three phases (18.45±3.76mSv, t=4.37, P<0.01).

CONCLUSION

In liver, virtual unenhanced (VU) CT imaging derived from gemstone spectral imaging (GSI) provides compatible image quality and tumor detection rate, compared with conventional unenhanced (CU) CT imaging.

CLINICAL RELEVANCE/APPLICATION

In liver, virtual unenhanced (VU) CT imaging derived from gemstone spectral imaging (GSI) provides has potential to substitute of conventional unenhanced (CU) CT imaging.

Texture Analysis for the Classification of Focal Liver Lesions on Both Non-contrast Enhanced and Contrast-enhanced Triple-phase CT Images (Station #6)

Zaiyi Liu MD (Presenter): Nothing to Disclose, Yanqi Huang: Nothing to Disclose, Xin Chen MD: Nothing to Disclose, Dan Pan: Nothing to Disclose

PURPOSE

To investigate the ability of texture analysis(TA) for classification of focal liver lesions including pure cysts, hemangiomas(HEM), focal nodular hyperplasia(FNH), metastatic carcinoma(MET), hepatocellular carcinoma(HCC) and intra-hepatic cholangiocarcinoma(ICC) on both non-contrast enhanced CT(NECT) and contrast-enhanced triple-phase CT(CECT).

METHOD AND MATERIALS

CT images of 318 patients(138 women and 180 men; mean age, 42yrs) with diagnosis of FNH(n=34), HCC(n=60), ICC(n=44), hemangioma(n=60) and pure cyst(n=60) were retrospectively analyzed. All patients underwent NECT and CECT scan on the same CT unit with one standard protocol. A complete list of texture features derived from gray-level histogram, co-occurrence and run-length matrix, gradient, autoregressive model, and wavelet transform were calculated using a TA software (MaZda) with region of interest manually placed on targeted lesion. Feature selection was performed using methods of Fisher score, probability of classification error and average correlation(POE+ACC,PA), mutual information coefficients(MI) and combination of (F+PA+MI). Linear discriminant analysis(LDA) in combination with k nearest neighbor(k-NN) classification was used for lesion classification.

RESULTS

For all groups, TA gave lower misclassification rates(MCR) on CECT compared to NECT. Pure cyst could be easily discriminated from other focal liver lesions with the minimum MCR of 0% on both arterial and portal venous phase. For discrimination of benign from malignant solid lesions, TA achieved the lowest MCR of 13.57% on portal venous phase, while the highest MCR of 37.50% on NECT. High classification accuracy of 95.74% was observed for discrimination between FNH and HEM, while the lowest MCR of 37.50% on NECT. High classification accuracy of 95.74% was observed for discrimination between FNH and HEM on both arterial and portal venous phase. In malignant group, with the feature sets selected by either Fisher score or POE+ACC, or F+PA+MI, MCR lower than 41% were achieved on arterial phase, while NECT yielded a surprisingly low MCR of 39.02% with MI method.

CONCLUSION

TA provided excellent accuracy for discrimination between cyst and other focal liver lesions, between benign and malignant lesions, and between benign lesions. Contrast-enhanced CT images contained the most relevant discrimination textural information compared to NECT.

CLINICAL RELEVANCE/APPLICATION
Based on contrast-enhanced CT images, texture analysis can be able to differentiate between benign and malignant focal liver lesions and aid in clinical practice.

**Intraductal Papillary Mucinous Neoplasm of Pancreas: Diagnostic Performance of CT and MR According to International Consensus Guidelines 2012 (Station #7)**

**Jae Ho Byun MD: Nothing to Disclose, Nieun Seo MD (Presenter): Nothing to Disclose, Jin Hee Kim MD: Nothing to Disclose, Seung Soo Lee MD: Nothing to Disclose, Hyoun Jung Kim MD: Nothing to Disclose, Moon-Gyu Lee MD: Nothing to Disclose**

**PURPOSE**

To investigate the diagnostic performance of CT and MR in patients with intraductal papillary mucinous neoplasm (IPMN) of pancreas according to international consensus guidelines 2012.

**METHOD AND MATERIALS**

158 patients with surgically confirmed IPMN of pancreas who underwent preoperative both CT and MR imaging were included in this retrospective study. According to pathologic results, IPMN was categorized into branch-duct (BD) IPMN and main duct (MD) IPMN including combined IPMN. Two abdominal radiologists evaluated the “high-risk stigmata” and “worrisome features” according to international consensus guidelines 2012 on CT and MR imaging in consensus. Univariate and multivariate analyses were used to identify significant predictors of malignancy in pancreas IPMN, including invasive carcinoma and high-grade dysplasia. Sensitivity and specificity of each significant finding for diagnosing malignant IPMN were also calculated. McNemar test was used to compare diagnostic accuracy of CT and MR.

**RESULTS**

60 patients had BD IPMN and 98 patients had MD IPMN. In 60 patients with BD IPMN, diameter of main pancreatic duct, presence of mural nodule, mural nodule size, enhancement of mural nodule, and thick septa were significant on univariate analysis (P<.05), with sensitivity of 62.5-84.6% and specificity of 50-84.6% on CT and of 62.5-84.6% and 50-82.7% on MR. In 98 patients with MD IPMN, presence of mural nodule, mural nodule size, enhancement of mural nodule, and lymphadenopathy were significant on univariate analysis (P<.05), with sensitivity of 34.1-68.2% and specificity of 81.5-92.6% on CT and of 29.6-72.7% and 83.3-96.3% on MR. On multivariate analysis, presence of mural nodule was the most important predictor in both types of IPMN (P<.05), whereas mural nodule size and lymphadenopathy were significant in only MD IPMN (P<.05). Diagnostic performance of CT and MR for each significant finding was not statistically different in both types of IPMN (P>.05).

**CONCLUSION**

According to international consensus guidelines 2012, presence of mural nodule was the most important predictor of malignancy in both types of IPMN. CT and MR showed no significant difference in differentiating malignant from benign IPMN.

**CLINICAL RELEVANCE/APPLICATION**

This study provided predictors of malignancy and their diagnostic performance in BD IPMN and MD IPMN according to the international consensus guidelines 2012 on CT and MR imaging.

**How to Perform and Interpret MR Enterography Studies without Antiperistaltic Agents, including Peristalsis Evaluation (Station #8)**

**Amelia Wnorowski MD (Presenter): Nothing to Disclose, Flavius F. Guglielmo MD: Nothing to Disclose, Donald G. Mitchell MD: Consultant, CMC Contrast AB**

**TEACHING POINTS**

1. MR enterography (MRE) can be successfully performed and interpreted without the use of antiperistaltic agents. Advantages to this approach include lower cost, less side effects and less interruption in workflow in some instances. 2. The main limitation of MRE without antiperistaltic agents is degraded image quality due to motion artifact. This limitation can be reduced by properly selecting cases and by using a multi-parametric approach when interpreting studies, including evaluating small bowel peristalsis for abnormal decreased motility.

**TABLE OF CONTENTS/OUTLINE**

**Background**

1. Limitations of antiperistaltic agents
2. Motion artifact from bowel peristalsis when not using antiperistalsics
   a. Which pulse sequences have the most motion artifact and which have the least
3. Proper interpretation requires a multi-parametric approach
   a. Using multiple pulse sequences to make the diagnosis
   b. Peristalsis evaluation
4. Review of MRE indications that do not require antiperistaltics: inflammatory bowel disease, small bowel obstruction, celiac disease, and known small bowel or mesenteric masses

**MRE Protocol without using antiperistalsics**

**Cine MRE pulse sequence**

1. How to perform and interpret a cine balanced steady-state free precession pulse sequence

**Sample cases with cine clips**
Unusual Types of Non-alcoholic and Non-biliary Pancreatitis - A Clinico-radiological Spectrum
(Station #9)
Chinmay Bhimaji Kulkarni MBBS, MD (Presenter): Nothing to Disclose, Srikanth Moorthy MD: Nothing to Disclose, Sreekumar K P MBBS, MD: Nothing to Disclose, Rajesh Ramaiah Kannan MD: Nothing to Disclose, Saket Bharat Thakar MBBS: Nothing to Disclose

TEACHING POINTS
1. Describe the epidemiologic, etiopathogenetic, clinical, and imaging characteristics of various nonalcoholic, nonbiliary pancreatitis syndromes. 2. Discuss the impact of imaging in management of these patients.

TABLE OF CONTENTS/OUTLINE
Aetiology, Epidemiology and clinical features of pancreatitis. Pathogenesis (genetic and molecular pathology) Distinctive imaging features. Impact of imaging in management of these patients.

New Functional Techniques in the Pancreas (Station #10)
Lidia Alcala Mata MD: Nothing to Disclose, Antonio Luna MD: Nothing to Disclose, Alvin C. Silva MD: Nothing to Disclose, Yoshihsa Tsuji MD: Nothing to Disclose, Jordi Broncano MD: Nothing to Disclose, Mariano Volpacchio MD (Presenter): Nothing to Disclose

TEACHING POINTS
- To review the newer functional approaches with CT and MRI that can be used to assess focal and diffuse pancreatic diseases, including the derived biomarkers
- To highlight the current and potential clinical applications of these imaging techniques

TABLE OF CONTENTS/OUTLINE

GI Upset: Drug-induced Injury in the Abdomen (Station #11)

TEACHING POINTS
Toxic gastrointestinal side effects of numerous prescribed medications are frequently discussed in clinical and pathology literature. Radiologic manifestations of drug-induced injury have also been described but are less frequently addressed, which may be due in part to a lack of knowledge of the patient's medications and in part to the often subtle or nonspecific imaging findings. It is therefore important for radiologists in training and practicing radiologists to be familiar with complications in the gastrointestinal tract related to common medical therapies and how they may present on various imaging modalities. Incidence and mechanism of several common medication-induced injuries, as well as their imaging findings and disease processes that can have a similar imaging appearance, will be reviewed in the esophagus, stomach, small bowel, colon, liver and pancreas.

TABLE OF CONTENTS/OUTLINE
Cases will include, but are not limited to: Pill induced esophagitis NSAID related gastric ulcers and intestinal webs Bowel wall hematoma related to anticoagulation Chemotherapy related bowel pneumatisis and perforation Antibiotic related colitis Hepatic steatosis related to chemotherapy Sinusoidal obstructive syndrome related to antimitabolites Hepatic adenomas related to oral contraceptive pills Pancreatitis related to chemotherapy

Beyond Adenocarcinoma—An MR Imaging Approach to Uncommon Neoplasms of the Ischiorectal Fossa (Station #12)
Kristy Lee MD (Presenter): Nothing to Disclose, Shamir Rai BSC: Nothing to Disclose, Kathryn Darras MD: Nothing to Disclose, Charlotte Jane Yong-Hing MD, FRCP: Nothing to Disclose, Patrick Martin Vos MD: Nothing to Disclose, Cameron John Hague MD: Nothing to Disclose, Alison Clare Harris MBChB: Nothing to Disclose, Silvia D. Chang MD: Nothing to Disclose, Karen Sisi Lee MD: Nothing to Disclose, Savvas Nicolaou MD: Nothing to Disclose

TEACHING POINTS
1. Review the normal anatomy and important landmarks of the ischiorectal fossa on MRI 2. Review the MR imaging features of uncommon masses in the ischiorectal fossa and the best sequences to evaluate these masses 3. Develop a basic imaging approach that will help narrow the differential diagnosis

TABLE OF CONTENTS/OUTLINE
TABLE OF CONTENTS/OUTLINE

- Historical imaging approach and misconceptions of the ischiorectal fossa (IRF)
- Normal anatomy and important landmarks of the IRF and anorectum
- Utility and limitations of MR sequences for characterizing neoplasms
- Ddx based on location: arising from the anorectum (intraluminal, intra-luminal and extra-luminal), IRF, or rectal extra-peritoneal space extending into the IRF and intimately or not related to the sacrococcygeus
- Narrow the ddx based on tissue type and tumor composition
- Review what surgeons and oncologists want to know
- Discuss an imaging-based algorithm for evaluation and management with cases including rectal carcinoid, leiomyosarcoma, leiomyoma, primary rectal lymphoma, metastases, GIST, lipomas, liposarcoma, myxoid liposarcoma, aggressive angiomyxoma, mucinous adenocarcinoma (and arising from perianal fistulae), plexiform neurofibromas, schwannoma, malignant nerve sheath tumor, teratoma and chordoma, mimics such as pilonidal cyst disease, cystic lymphangiomata, etc.

GUS-TUA
Genitourinary/Uroradiology Tuesday Poster Discussions

Scientific Posters

AMa PRA Category 1 Credits: .50
Tue, Dec 2 12:15 PM - 12:45 PM  Location: GU Community, Learning Center

Participants
Moderator
Dean Akira Nakamoto MD: Research Grant, Galil Medical Ltd

Sub-Events

GUS121
Upper Tract Urothelial Cancers Identified on CT Urography: A Six-year Review (Station #1)
Ellie Rose Lee MD ( Presenter): Nothing to Disclose, Bryan Michael Hoag MD: Nothing to Disclose, Lauren Marie Brubaker Burke MD: Consultant, Amgen Inc, Julia R. Fielding MD: Nothing to Disclose

PURPOSE
To identify upper tract tumors in those patients undergoing CT urography for hematuria and/or history of urothelial cancer.

METHOD AND MATERIALS
The study was IRB approved and HIPAA compliant. A retrospective review was performed on 2054 adult patients (median age, 56 years; range 18-94 years) who underwent CT urography (CTU) examination at a single institution between October 2006 and October 2012 for evaluation of hematuria and/or history of urothelial cancer. Patients were identified via electronic medical records. A standardized multi-phase CT urography protocol was used over the six-year time frame which included 5 mm axial non-contrast, post-contrast, and delayed images through the kidneys and bladder and 3 mm coronal reformats in the delayed phase. All CT urograms were interpreted by radiologists specializing in abdominal imaging. The radiology reports were reviewed for urothelial lesions. The medical charts and pathologic results were reviewed for those patients with positive CT urograms.

RESULTS
Of the 2054 patients, 114 (5.6 %) were positive for pathology proven urothelial tract cancer on CT urography examination. 86 of the 2054 (4.2 %) patients had bladder masses on CTU, 25 of the 2054 (1.2%) patients had upper tract lesions on CTU, and 3 of the 2054 (0.2 %) patients had both upper tract and bladder lesions on CTU.

CONCLUSION
Upper tract urothelial cancers are extremely rare in a tertiary care institution. Only 1 % of the patients who underwent CT urograms for hematuria or for history of urothelial cancer were positive for upper tract disease. This should prompt reconsideration of indications for interval follow-up or surveillance with this high radiation dose exam.

CLINICAL RELEVANCE/APPLICATION
CT urography for hematuria and/or history of urothelial cancer was positive in only 1% of patients, and interval surveillance intervals should be reconsidered to avoid unnecessary radiation exposure.

GUS122
Post-Cystectomy Hernias: Lessons Learned in Appropriate Reporting and Detection (Station #2)
James Reza F. Fernandez MD, MS (Presenter): Nothing to Disclose, Hooman Djaladat MD: Nothing to Disclose, Kamran Movassaghi: Nothing to Disclose, Vinay Anant Duddalwar MD, FRcR: Research Grant, General Electric Company

PURPOSE
Post-cystectomy hernias, designated as incisional or para-stomal depending on whether an ileal conduit or neobladder is constructed, are not uncommon complications of surgery. Radiologists sometimes under-report such hernias for a variety of reasons, including small size (<1 cm) or, in the case of parastomal hernias, attributing them to normal post-operative change. In addition, some hernias appreciated on clinical exam are not identified during cross-sectional imaging as they may reduce at the time of the scan. This project was aimed to identify what types of hernias were missed, the hernia defect sizes, and correlation with clinical exam
findings to identify occult hernias which were not identified at the time of the scan. The ultimate goal was to identify the cause of under-reporting hernias, and to adjust scanning protocols to maximize sensitivity for detecting hernias.

RESULTS

Approximately 18 out of 401 patients were found to have parastomal hernias postoperatively. Another 3 were found to have clinical evidence of parastomal hernias, without corresponding cross-sectional imaging findings. Another 122 patients were found to have clinical evidence of incisional hernias, of which 51 were not seen radiographically.

CONCLUSION

Two changes were implemented as a result of this: 1) Protocol for post-cystectomy patient surveillance imaging of the abdomen and pelvis is now performed during valsalva to maximize hernia manifestation 2) Radiologists were notified of the study findings, and educated expected post-surgical stoma formation findings, and encouraged to report any fascial defects > 1 cm along incision lines given their propensity to enlarge over time.

METHODS

401 post-cystectomy patient CT scans of the abdomen and pelvis, for which reports did not have any mention of post-operative hernias (other hernias, including hiatal, umbilical, or inguinal, were not excluded), were reviewed retrospectively for presence of hernias. Any hernias identified were then analyzed for hernia contents and abdominal wall defect size.

GUS123

Testicular Microlithiasis: Is Ultrasound Surveillance Necessary? A 14 year Experience in 461 Patients in a Single Centre (Station #3)

Ketul Patel (Presenter): Nothing to Disclose, Subash Navaratne MBBS, MRCS: Nothing to Disclose, Emily Bartlett: Nothing to Disclose, Maria E. Sellers MD, FRCR: Nothing to Disclose, Jane L. Clarke MS: Nothing to Disclose, Paul Singh Sidhu MRCP, FRCR: Speaker, Bracco Group Speaker, Siemens AG Speaker, Hitachi, Ltd

PURPOSE

Testicular microlithiasis (TM) is frequently an incidental finding on ultrasound (US). An increased incidence of germ cell tumours (GCT) is seen in the presence of TM suggesting TM is a premalignant condition and routine surveillance is advocated. There is no evidence of a causal link between TM and the development of GCT. We present the largest cohort of patients with TM followed up in a single centre and deliberate on the merits of annual US surveillance.

METHOD AND MATERIALS

A retrospective analysis of male patients undergoing US of the testis for a variety of reasons between 1998 and 2012 was performed. Routine 1-yearly US follow-up was offered to all patients with TM and a database of attendances was maintained. Patient demographics, follow-up details and the development of a testicular mass were recorded. For those found to have a testicular mass, detailed analysis of the radiological and histological findings were recorded. The TM was divided into limited (5 microliths/field) and florid (‘snowstorm’ appearance). Any co-existing tumor at presentation with background TM was recorded.

RESULTS

20,224 patients were examined with US of which 867 (4.3%) (median age 38 years, range 4-86) had TM. 21/867 (2.4%) had neoplastic tumors on presentation. All patients consented to follow-up with 461 patients (55%) achieving this and entered into the follow-up program (median duration 420 days, range 138-4957). Three patients developed tumors during the follow-up period, two of which were malignant (seminomas), the other a benign adenomatoid tumor. Of the two malignant tumors, one had a history of orchiectomy for contralateral GCT and developed a palpable mass on day 616 of follow-up. The other had an atrophic testis and the tumor was found at day 1886 of follow-up. There was no relationship to the classification of the TM.

CONCLUSION

On follow-up of 461 patients with TM for median duration of 420 days, we demonstrated the de-novo occurrence of GCT in only 2 patients. Both of these patients were high risk exclusive of their TM status. Our findings strongly support the impression that patients with TM and no other clinical risk factors for testicular GCT do not require routine surveillance.

CLINICAL RELEVANCE/APPLICATION

We present 14 year data of the largest single centre cohort of patients with testicular microlithiasis and demonstrate no increase in the tumour detection rate from routine ultrasound surveillance.

GUS124

Usefulness of Low-dose Non-enhanced CT with Hybrid Iterative Reconstruction for Evaluation of Urolithiasis: Diagnostic Performance and Agreement between the Urologist and the Radiologist (Station #4)

Joonho Hur (Presenter): Nothing to Disclose, Sung Bin Park MD: Nothing to Disclose, Jong Kyu Kwon: Nothing to Disclose, Jong Beum Lee: Nothing to Disclose, Hyun Jeong Park: Nothing to Disclose, Yang Soo Kim MD: Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the efficacy of iterative reconstruction (IR) technique for reducing image noises in low-dose non-enhanced CT (LDCT) and the diagnostic performance of LDCT-IR for urolithiasis.
METHOD AND MATERIALS

116 patients diagnosed with urinary stones (n=197) using both a standard dose non-enhanced CT using filtered-back projection (SDCT-FBP, 120 kV and 150 mAs) and a low dose non-enhanced CT using hybrid IR (LDCT-IR, iDOSE4 level 5, 100 kV and 60 mAs) were enrolled in the study. Interpretations of the two scans were performed prospectively with respect to stone characteristics (size, volume, location, Hounsfield unit (HU), skin-to-stone distance (SSD)), radiation dose, objective image noise, and subjective image assessment. With SDCT-FBP as the reference standard, diagnostic performance and inter-observer agreement of LDCT-IR for urinary stones according to the stone size; all sizes, ≥ 3 mm, and <3 mm were assessed between one urologist and one radiologist.

RESULTS

No statistically significant differences were found in stone characteristics between the two scans. The average effective radiation dose of SDCT and LDCT was 5.92 mSv, and 1.39 mSv, respectively, and the average radiation dose reduction rate was 76.6% (p<0.001). Objective image noise was higher in LDCT-IR (p<0.01), but there were no significant differences in subjective image assessment between the two scans. The sensitivity and specificity of LDCT-IR were 99.1% to 100.0% with a diagnostic accuracy of 99.1% to 99.6% for diagnosing stones ≥3 mm. All statistical parameters for diagnostic accuracy were similar between the urologist and radiologist (p>0.05, respectively). Inter-observer agreement of LDCT-IR between the two reviewers in the diagnosis of stones was high with kappa values ranging from 0.901 to 1.000 in all three groups.

CONCLUSION

LDCT-IR provided a significant reduction in radiation dose while maintaining the image quality comparable to that of SDCT-FBP, thus making it an attractive option for the urologist as well as radiologist for diagnosing urinary stones.

CLINICAL RELEVANCE/APPLICATION

Patients with urolithiasis can be evaluated with low dose non-enhanced CT using hybrid iterative reconstruction at a substantially reduced radiation dose by urologist as well as radiologist, thereby minimizing risks to patient from radiation exposure while providing the diagnostic benefits of low dose non-enhanced CT using iterative reconstruction.

URE145

Ten Hiding Habits of Clinically Significant Prostate Cancer (Station #6)

Andrew B. Rosenkrantz MD (Presenter): Nothing to Disclose, Sadhna Verma MD : Nothing to Disclose, Baris Turkbey MD : Nothing to Disclose

TEACHING POINTS

Given the increasing role of multi-parametric MRI in guiding targeted prostate biopsies, it is imperative that the interpreting radiologist have a thorough knowledge of the many different locations and appearances of prostate tumors on such examinations. The purpose of this exhibit is to expose radiologists to a range of unusual or less common presentations of prostate tumors on MRI and to provide pointers to aid in accurately diagnosing such cases, including the key role of multi-parametric imaging in this assessment.

TABLE OF CONTENTS/OUTLINE

Case presentations will comprise representative examples of prostate tumors with an unusual location or appearance, along with accompanying discussion highlighting the key MRI features. The list of cases includes:

URE174

The Radiology of Hematuria — What the Urologist Wants to Know (Station #7)

Katherine Joy Too MD : Nothing to Disclose, Ali M. Tahvildari MD (Presenter): Nothing to Disclose, Kendra Klang MD : Nothing to Disclose, Geoffrey Sonn MD : Nothing to Disclose, Michael Peter Federle MD : Nothing to Disclose

TEACHING POINTS

1. Review the management of hematuria and the imaging modalities for evaluating hematuria, including their advantages and limitations. 2. Describe the imaging findings for common and uncommon causes of hematuria and common pitfalls in imaging interpretation. 3. Discuss the management implications of imaging findings in the radiologist’s report.

TABLE OF CONTENTS/OUTLINE

I. Definitions and classifications of hematuria - Gross versus microscopic - Nephrologic versus urologic II. Clinical evaluation - Urinalysis - Cystoscopy - Imaging - Ureteroscopy, Retrograde ureteropyelography III. Role of imaging - Abdominal radiographs - Conventional IVP - Ultrasound - CT - MR IV. Causes of hematuria that can be identified on imaging and what the urologist wants to know with sample cases - Common causes - Less common causes - Rare causes V. Pitfalls in interpretation and benign mimics
HPS152

**Hospital Level Factors Associated with High Utilization of In-hospital CT in Japan (Station #1)**

Kanako Kunishima Kumamaru MD, PhD (Presenter): Nothing to Disclose, Hiraku Kumamaru: Nothing to Disclose, Hideo Yasunaga: Nothing to Disclose, Shigeki Aoki MD, PhD: Nothing to Disclose, Kuni Ohtomo MD: Research Grant, Bayer AG Research Grant, DAIICHI SANKYO Group, Frank John Rybicki MD, PhD: Research Grant, Toshiba Corporation, Ruth M. Dunne MBCh: Nothing to Disclose, Amir Imanzadeh MD: Nothing to Disclose

**PURPOSE**

In Japan, CT scanners are readily available and individual imaging costs are low. Thus, CT is an "easy to perform" test that can be overutilized. The purpose of this study is to evaluate the hospital level factors associated with higher CT utilization using a nationwide Japanese administrative database.

**METHOD AND MATERIALS**

This retrospective (04/2012-03/2013) study used data from the Japanese nationwide administrative database of 1108 hospitals. The target population was patients who received total knee or hip replacement surgeries at hospitals meeting an inclusion criteria based on 30 or more procedures annually. We fitted logistic regression models with generalized estimating equations to identify hospital level factors associated with patient's probability of undergoing CTs, while adjusting for patient level factors including age, sex, BMI, smoking status, pre-existent comorbidities, history of deep vein thrombosis, operative type (knee or hip), surgical time, transfusion during surgery, postoperative events, and length of stay.

**RESULTS**

A total of 448 hospitals met the inclusion criteria, and in these institutions, 37,110 patients underwent the procedure. During the median length of stay of 25 days (IQR:20-33), 7307 (19.7%) patients underwent post procedure CT. CT utilization was not homogeneous among hospitals. At majority (57.2%) of hospitals, less than 10% of patients had post procedure CT. However, more than 50% of patients had a CT at the 46 (10.3%) high utilization hospitals. Multivariable analysis identified academic status of the hospitals (99/448 hospitals) to be strongly associated with an increased probability of undergoing post procedure in-hospital CTs (adjusted odds ratio:4.22 (95%CI:1.91-9.32), p=0.003), while other hospital characteristics (number of beds, availability of radiologists, number of surgeons and total number of procedures during the year) were not.

**CONCLUSION**

We observed great variability in the utilization of post procedure CT in this Japanese cohort. Patients treated at academic facilities were more likely to have in-hospital CT after total knee or hip replacement compared to those treated at non-academic hospitals, even after adjusting for patient and hospital level factors.

**CLINICAL RELEVANCE/APPLICATION**

This Japanese database study showed an association between higher CT utilization after total knee or hip replacement surgery and academic status of the hospitals, which may need further investigation.

HPS153

**Using Software based Solution for Quality Assurance in a Sub Specialized, Multivendor CT Practice (Station #2)**

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

**PURPOSE**

To evaluate the effectiveness of an automated dose monitoring (ADM) in assuring success to adhere with dose optimization protocols using kidney stone CT exams (KSCT) as a model.

**METHOD AND MATERIALS**

In this IRB approved study, all kidney stone exams performed between January 2013-January 2014 on 17 of 21 scanners (GE=12, Philips=2 and Siemens=3) were retrieved using an ADM software (eXposure TM, Bayer). Out of total 136,254 exams, 1935 exams (M:F=1031:904, Age=56.7 Years, BW=81 Kgs) were performed for kidney stone indications. Mean radiation doses (SSDE, DLP) were tracked for different scanners, vendors, reconstruction techniques, technicians, time of scan and radiation dose outliers (>2 SD above mean) were identified using a box plot. Doses were compared with DIR National averages.
RESULTS
Mean Radiation doses (SSDE=9.8±3.9 mGy, DLP=420.1 ±240mGy-cm) were 38% lower than national averages (DIR feedback report 2013). In 75 patients DLP greater than 2SD (> 900mGy-cm) was noted, of these 70 patients had excessive body weight (mean=112.4 Kgs). In 3 patients higher doses were due to increase in scan area while in 2 patients, incorrect protocols was applied. The exam protocols were reviewed with 3 technicians involved in these 5 exams and proper education was provided. The time of scan acquisition i.e. 8 AM to 6 PM or after 6 PM had no impact on radiation dose outliers.

CONCLUSION
ADM software enabled us to identify 5 patients who received radiation doses higher than expected due to protocol violations, necessitating need for continuous dose tracking and continued education and training of technologists and radiologists.

CLINICAL RELEVANCE/APPLICATION
Close monitoring of radiation doses is essential to adhere to ALARA principle and improve patient care. ADM software is effective way of tracking dose outliers and any protocol deviations and paves path for quality assurance in CT and provides opportunity for education and continuous protocol optimizations.

HPS154
Echocardiography Manifests Substitutability with Other Cardiac Imaging Modalities in the Ordering Patterns of Referring Providers (Station #3)

Mark D. Hiatt MD, MBA (Presenter): Medical Director, Regence BlueCross BlueShield Board Member, RadSite Former Chief Medical Officer, HealthHelp, LLC , Mark S. Holdaway BS : Nothing to Disclose

PURPOSE
To observe the degree to which cardiac MRI, CT, SPECT, and PET (non-echo procedures) may substitute for echocardiography (echo) by examining the ordering patterns of providers before and after the recent implementation of a program to manage the utilization of echo, with the resulting need to seek prior authorization considered an additional ‘cost’ of ordering echo under demand theory in economic science.

METHOD AND MATERIALS
The ordering of echo and non-echo procedures, as defined by Current Procedural Terminology code and discerned through claims data, by providers in 4 states in the United States caring for approximately 1.5 million commercial and Medicare members of a health insurance plan was tracked from the beginning of November 2010 to the end of October 2013. A program to manage outpatient echo utilization, administered by a radiology benefit manager, was instituted in December 2012. (A similar program to manage non-echo utilization had been in place at the time of this implementation, beginning in Juné 2009 and phased in during subsequent months.)

RESULTS
During the 3-year study period, 265,704 echo and non-echo procedures were performed in the population under review. With the implementation of echo utilization management (UM), the relative ordering of echo and non-echo procedures changed as anticipated, declining by 4.1% for echo (from 48.4 to 46.4 units per 1,000 members), but increasing for non-echo procedures by 3.8% after echo UM implementation, compared to a decrease of 3.7% before implementation (yielding an overall decline from 12.3 to 11.5 units per 1,000 members).

CONCLUSION
The cross elasticity of demand between echo and cardiac MRI, CT, SPECT, and PET is positive, as apparent substitution was observed as a result of the recent program implementation. Other confounding factors may have been at play during the study period, including rising concern about excessive medical radiation (except, of course, for MRI) and campaigns to address inappropriate ordering such as the Choosing Wisely initiative; however, these influences would have tended to reduce, not increase, non-echo utilization as a whole, thus supporting the hypothesis of substitutability.

CLINICAL RELEVANCE/APPLICATION
These results suggest that ordering patterns for diagnostic imaging may be less entrenched than expected, with such other considerations as changes in relative ordering convenience overcoming ingrained preferences for modality.

HPS155
Liver and Kidney Biopsies: Changing Roles of Radiologists and Other Specialists from 1991 – 2012 (Station #4)

Wesley A. Angel MD (Presenter): Nothing to Disclose , C. Matthew Hawkins MD : Nothing to Disclose , Jennifer M. Wang PhD : Nothing to Disclose , Danny Hughes PhD : Nothing to Disclose , Richard Duszak MD : Nothing to Disclose

PURPOSE
To evaluate national specialty trends in hepatic and renal biopsies over two decades.
**METHOD AND MATERIALS**

Medicare Physician Supplier Procedure Summary (PSPS) master files were analyzed from 1991 to 2012 for hepatic and renal biopsies (CPT codes 47000, 50200). Procedure volumes were collected for radiologists, various specialist groups, primary care physicians, surgeons, and advanced practice providers (nurse practitioners and physician assistants). All other providers were combined. Changes and trends over time were analyzed.

**RESULTS**

Between 1991 and 2012, the frequency of liver biopsies in Medicare Part B beneficiaries increased from 25,318 to 53,055 (+110% increase) and kidney biopsies increased from 11,599 to 32,762 (+182% increase). The number of liver and kidney biopsies performed by radiologists increased from 4,277 to 46,181 (+980%) and 1,325 to 23,003 (+1636%) respectively. For most other specialties, procedure volumes declined, with the exception of nephrologists, who experienced a modest 52% increase from 1991 to 2012. Overall, the proportion of liver and kidney biopsies performed nationally by radiologists increased from 17% to 87% and from 11% to 70% respectively. Prior to 2002, advanced practice providers performed few biopsies. Since 2002, the number of liver and kidney biopsies performed by advanced practice providers has increased by 274% and 1,267% respectively.

**CONCLUSION**

Since 1991, the number of liver and kidney biopsies has increased and the proportion of those procedures performed by radiologists has increased dramatically. This may be due at least in part to the safety-driven movement towards image-guidance for procedures, but the economics related to declining procedural reimbursement may be contributing. Over that time, the acceptance of procedures performed by advanced practice practitioners has increased substantially.

**CLINICAL RELEVANCE/APPLICATION**

Radiologists are now by far the largest providers of hepatic and renal biopsies on Medicare beneficiaries.

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**INS-TUA**

**Informatics Tuesday Poster Discussions**

**Scientific Posters**

**INS148**

*A Software Tool to Quantify Hemodynamic Parameters from Digital Subtraction Angiography (Station #1)*

Patricia Del Castillo Hernandez : Nothing to Disclose, Roberto Sanz-Requena PhD : Nothing to Disclose, Ignacio Bosch-Roig : Nothing to Disclose, Fernando Aparici-Robles MD : Nothing to Disclose, Luis Marti-Bonmati MD, PhD (Presenter): Nothing to Disclose

**CONCLUSION**

Registered post-processing imaging software for quantitative parametric DSA analysis is now available, providing objective and reliable information of the cerebral hemodynamic situation before and after endovascular treatment.

**Background**

Cerebrovascular disease is the most common cause of disability in adults, being carotid stenosis responsible of 25% of strokes. Endovascular treatment has emerged as an alternative to medical and surgical treatment of carotid stenosis. After stenosis resolution, digital subtraction angiography (DSA) allows to observe changes in different hemodynamic parameters, such as cerebral blood flow (CBF), blood volume (CBV) and mean transit time (MTT). Treatment evaluation may objectively quantify changes in these parameters at the pixel level. To do that properly, there is a need to correct patient motion artifacts. The aim of this study is to introduce a software tool to accurately assess the motion-corrected absolute values and relative variations after endovascular treatment of CBF, CBV and MTT.

**Evaluation**
Recent studies have evaluated mobile displays for conventional radiography tasks such as tuberculosis calcifications, and asymmetries in order to clarify the iPad’s utility in mammography. Further studies are needed to analyze the iPad’s lesion detection for features such as masses, trained breast imagers. Initial data suggests the iPad may have similar performance for identifying positive findings.

**CONCLUSION**

The iPad has similar performance to a conventional workstation for classifying breast composition across reading-room workflow, rather than viewing cases passively in a conference. This system accomplishes this, as well as providing projection images, it is possible to calculate tissue CBF, CBV and MTT values, allowing objective treatment evaluation.

**Discussion**

Currently, assessment of hemodynamic changes in angiographic studies is done qualitatively. Although DSA provides projection images, it is possible to calculate tissue CBF, CBV and MTT values, allowing objective treatment evaluation.

**Comparison between iPad3 and Conventional Workstation for Assessment of Breast Composition and Abnormal Cases (BIRADS 0) in Screening Mammography (Station #3)**

Chin-Hsiang Feng BS (Presenter): Nothing to Disclose, Samir Abboud MD: Nothing to Disclose, Jessica Ann Galandak MD: Nothing to Disclose, Lyn Wan Ho MD: Nothing to Disclose, Scott Rotenberg 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, Artis ZeeQ 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 Research Grant, Cristina Irene Caterina Campassi MD: Nothing to Disclose

**CONCLUSION**

The iPad has similar performance to a conventional workstation for classifying breast composition across trained breast imagers. Initial data suggests the iPad may have similar performance for identifying positive screenings. Further studies are needed to analyze the iPad’s lesion detection for features such as masses, calcifications, and asymmetries in order to clarify the iPad’s utility in mammography.

**Background**

Recent studies have evaluated mobile displays for conventional radiography tasks such as tuberculosis...
screening. This study investigated the use of the iPad3 display for ultra high resolution tasks such as mammography.

Evaluation

We compared the iPad3 3.1 megapixel display using the MobileMIM app with an AGFA IMPAX workstation with SMP monitors for the evaluation of two parameters: breast composition and positive screening mammograms. Positive screening mammograms were defined as abnormal cases (BIRADS 0). Negative screening mammograms were defined as negative (BIRADS 1) or benign (BIRADS 2) cases. We selected 60 digital screening mammograms with a biopsy diagnosis or a minimum of 2 years of follow-up to represent all 4 groups of breast composition. The dataset was enhanced, increasing the positive cases to 25%. Of these cases, 32 were interpreted with and 28 without a prior screening mammogram. The dataset was anonymized and read in randomized order first on the iPad and then on the workstation with a 2 week interval between sessions. Four radiologists, 3 attendings with varying expertise in breast imaging and 1 fellow in training, interpreted the cases blinded to outcome. Breast composition, lesion type and location, and assessment category were recorded for each case according to BIRADS standards. For each reader, the interpretation on the workstation served as the gold standard, and the performance of the two displays was evaluated by kappa statistics.

Discussion

For breast composition, the iPad and SMP comparison yielded a substantial kappa value ranging from 0.63 to 0.78 in all readers. For the positive screening assessment, the iPad and SMP comparison yielded a fair kappa value of 0.39 for the fellow and a moderate to substantial kappa value of 0.56 to 0.72 for the attendings.

Semi-automated Small Bowel Segmentation with Automated Centerlining on Thin-slice CT (Station #4)

Ryan Michael Kohlbrenner MD (Presenter): Nothing to Disclose, Aliya Qayyum MBBS: Spouse, Employee, Imorgon Medical, David E. Avrin MD, PhD: Stockholder, Reed Elsevier

PURPOSE

The small bowel is time-consuming to track and evaluate on CT and is challenging to automatically segment. The purpose was to determine the feasibility of small bowel tracking by developing a computerized algorithm that segments the small bowel lumen and generates its centerline as a reference for creation of reformatted images in cross section to the lumen.

METHOD AND MATERIALS

A computerized scheme was developed using the Insight Segmentation and Registration Toolkit. Three CT scans with well-distended small bowel were included in the study, including one CT enterography and two CT scans with small bowel obstruction. Beginning at a user-defined start point within the bowel lumen, a region-growing segmentation algorithm was used to accumulate neighboring intraluminal voxels of air or fluid attenuation until a user-defined endpoint within the lumen was reached. The distance between the two points was arbitrary, assuming loops of bowel between the points remained least partially distended. A secondary segmentation of the extraluminal abdominal contents was used to further refine the binary results by subtraction. The Euclidean distance transform of the binary segmentation volume was then generated (characterized by high values near the luminal center, low values at the periphery, and zero values for extraluminal voxels). Employing the transform as a cost function, where high values correspond to low cost, the minimal cost path between the two seed points was determined. The approximate centerline was superimposed on the original CT volume, and a series of images were generated perpendicular to the centerline.

RESULTS

Transluminal images perpendicular to the centerline were successfully generated for all cases in the test series, using maximally spaced user-defined seed points within the distended small bowel lumina. The line connecting the seed points remained within the small bowel lumen for each case.

CONCLUSION

Small bowel luminal segmentation can be performed in cases of partially or fully distended small bowel. Automated centerlining of the segmentation result facilitates generation of transluminal images, which would improve evaluation of small bowel pathology.

CLINICAL RELEVANCE/APPLICATION

Generating an enteric centerline and perpendicular images would improve localization and evaluation of small bowel pathology such as enteritis in Crohn disease, small bowel tumors, and the transition point in small bowel obstruction.
CONCLUSION

Despite a substantial reduction in report TAT in 2013 there was no evidence of a negative impact on the structural report quality. This may be explained by the assumption that TAT improvement is a matter of optimizing time efficiency and TAT awareness rather than shortening the time available for reporting.

Background

Radiology reports from a time period before reduction in TAT (06-12/2012) were compared to reports from a time period with significant reduction in TAT (06-12/2013). Plain text data from 1'812 radiology reports containing the keywords “pulmonary embolism” (PE) and “cerebral ischemia” (CI) were retrieved from the radiology information system. An advanced language processing approach was used to analyze the following objective criteria for report quality: word count and its variability, the number of addendums to reports and the adherence to common reporting structures (history, procedure, comparison, findings, impression). It was also assessed if the impression addressed the clinical question which initiated the procedure.

Evaluation

No significant difference in mean word count (CI: 108.3 to 127.7 words; PE: 125.4 to 125.4 words) and variability (standard deviation; CI: 48.0 to 58.7; PE: 65.4 to 64.2) was found. The number of addendums slightly increased but remained at a very low level in absolute numbers (CI: 0.8% to 1.5%; PE: 0.6% to 1.6%). The adherence to common reporting structures showed a slight improvement in some categories (e.g. reference to comparison studies, case history). 98.0% of reports addressed PE as clinical question in 2012, which changed to 97.8% in 2013 (CI: 73.0% to 66.1% respectively). The percentage of reports addressing PE in the line in the impression decreased from 69.3% to 65.0% (CI: 28.6% to 27.6% respectively).

Discussion

The approach of analyzing structural report quality can be used to detect changes in the report quality. In this work we could show that improving report TAT does not negatively impact report quality. Although this approach does not measure the clinical accuracy of reports, it offers objective measures of the care that goes into reporting.

INE017-b

Automatic Partitioning Torso CT Images based on Anatomical Definition and its Performance Evaluation by using a Large Dataset (custom application computer demonstration)

Xiangrong Zhou PhD (Presenter): Nothing to Disclose, Syoichi Morita: Nothing to Disclose, Takeshi Hara PhD: Nothing to Disclose, Ryujiro Yokoyama: Nothing to Disclose, Huayue Chen: Nothing to Disclose, Masayuki Kanematsu MD: Nothing to Disclose, Hiroshi Fujita PhD: Nothing to Disclose

Background

Understanding anatomical structures on CT images is an essential step of computer-based medical image analysis. Partitioning whole body region on a CT scan into a number of special organ or tissue units based on anatomical definition is the way to realize this tough task. Here, an organ unit is generally presented by a rotated bounding box that tightly covers a special organ region with a little background as small as possible. In this work, we demonstrate a computer system that can automatically and quickly partitioning a 3D volumetric CT scan into a number of organ or tissue boxes based on anatomical definition.

Evaluation

A dataset consisting of more than 4,000 volumetric CT scans was used for performance evaluation. These CT images were generated from 4 kinds of CT scanners by using different scan protocols for clinical diagnosis. The spatial resolution of the CT images varied from 0.62 mm to 5 mm. Eighteen major organs and tissues including heart, liver, gallbladder, spleen, pancreas, stomach, bladder, left-lung, right-lung, left-kidney, right-kidney, left-femur-head, right-femur-head, left-psosas-major-muscle, right-psosas-major-muscle, uterus and rectum, abdominal rectus muscle, and inferior vena cava (IVC) with ventral aorta were selected as partitioning targets. In this study, the bounding box was considered to be correct if most (two thirds of the volume) of the detected 3D box and the manually inputted box overlapped with each other.

Discussion

Our evaluation showed that the success rates for most targets were in the range of 95 % to 100 %, besides of stomach (94 %), spleen (90 %), pancreas (82 %) and gallbladder (84 %). Typical computing time for partitioning a torso CT scan using a general-purpose computer equipped with an Intel Core2Duo 2.23-GHz CPU was 2 minutes or less.

CONCLUSION

We developed a computer system that can be used to partition a CT scan into more than 18 kinds of major organ or tissue units automatically. The efficiency and accuracy were validated using a large dataset including more than 4,000 real clinical CT scans.

INE018-b

Planning Software of Minimally Invasive Needle Trajectory for Lung Biopsy in 3D Volumetric Chest CT: Considering Quantitative Pulmonary Vessels Invasiveness and Distance from Virtual Walls (custom application computer demonstration)

Minho Lee PhD: Nothing to Disclose, Namkug Kim PhD (Presenter): Stockholder, Coreline Soft, Inc, Joon Beom Seo MD, PhD: Nothing to Disclose, Sang Min Lee MD: Nothing to Disclose

Background

Recently, image based biopsy has been popular, because CT fluoroscopy or C-arm fluoroscopy imaging modality
is becoming accurate and fast, by which the trajectory of biopsy needle can be guided and planned. Therefore, we proposed the automatic biopsy planning method to find minimally invasive insertion trajectory of biopsy needle in the pre-operation stage of volumetric chest CT.

**Evaluation**

Volumetric CT scans of twenty lung biopsy patients were performed. At first, semi-automatic multi-organ segmentation including rib-bone, airway, pulmonary vessels, heart, skin, and soft tissue were performed with in-house software. Then, distance maps from critical organs including lung boundary, peripheral of rib-bone, airway, pulmonary vessels, and heart and set 2mm as a safety margin from possible needle trajectory were generated. In addition, shortest and near vertical trajectory from skin to target lesion picked by the physician were evaluated. In conclusion, we developed the size based emphysema cluster segmentation and analysis platform, which would be useful for estimation of PFT parameters.

**Discussion**

This insertion trajectory planning which depends on the experience of a physician could be determination by the quantitative degree of invasiveness, such as blood vessels invasiveness and distance from virtual walls.

**CONCLUSION**

This method could be used for planning minimally invasive biopsy trajectory based on the quantitative degree of invasiveness, such as blood vessels invasiveness and distance from virtual walls.

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**INE19-b**

**Development of Fine-scale Size based Emphysema Cluster Segmentation and Analysis Platform using Length Scale and Unsupervised Clustering (custom application computer demonstration)**

Minho Lee PhD : Nothing to Disclose, Taekjin Jang (Presenter): Nothing to Disclose, Namkug Kim PhD : Stockholder, Coreline Soft, Inc, Sang Min Lee MD : Nothing to Disclose, Joon Beom Seo MD, PhD : Nothing to Disclose, Sang Young Oh MD : Nothing to Disclose

**Background**

In patients with chronic obstructive pulmonary disease (COPD), robust size based emphysema analysis is of importance, because size of emphysema cluster would be a surrogate imaging biomarker of etiology and progress of COPD, resulting in the morphological change of the emphysema. In this study, we developed a quantitative analysis on fine-scale size based emphysema in volumetric CT.

**Evaluation**

Volumetric CT scans of sixty patients with COPD were performed by a more than 16 MDCT scanner (Siemens Sensation 16 and 64) within 0.75mm collimation. Using thresholding by -950 HU, emphysema index (EI) of low attenuation area (LAA) mask within lung except airway was evaluated. Based on these LAA masks, a length scale analysis to estimate each emphysema cluster’s size was performed as follows. At first, Gaussian low pass filter from 30mm to 1mm kernel size with 1mm interval was performed iteratively. No changed voxel in the filtered volume was selected and dilated by the size of the kernel, regarded as the specific size emphysema cluster. In this way, emphysema clusters with specific size range was differentiated and evaluated. The power law D of area and number of size based emphysema cluster (slope of log-log plot) were evaluated and compared with pulmonary function test (PFT). All PFT parameters including DLco, FEV1, and FEV1/FVC were significantly correlated with D (r-values, -0.73, 0.54, 0.69, respectively) and EI (r-values, -0.84, -0.60, -0.68, respectively). In addition, D independently contributed regression for FEV1, FEV1/FVC (adjust R sq.: EI only, 0.70, 0.45; EI and D, 0.71, 0.51, respectively). In addition, size based emphysema clusters was visualized.

**Discussion**

Size based emphysema cluster segmentation and analysis evaluated the Ds of area, number, density histogram, extent, and distribution of size based emphysema cluster, which would be an independent factors for predictor of PFT parameters.

**CONCLUSION**

In conclusion, we developed the size based emphysema cluster segmentation and analysis platform, which would be useful for estimation of PFT parameters.

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**INE20-b**

**Automated Segmentation Method for Lung Tumor Attached to Neighbor Structures in Chest CT Images (custom application computer demonstration)**

Julip Jung MS (Presenter): Nothing to Disclose, Helen Hong PhD : Nothing to Disclose, Jin Mo Goo MD, PhD : Research Grant, Guerbet SA

**Background**

Lung tumor segmentation on chest CT images is essential and important to measure tumor size and volume for cancer diagnosis, treatment planning and therapy response assessment. One of the most challenging tasks is the separation of lung tumor from neighbor structures such as chest wall or mediastinum. Because lung tumor is often attached to chest wall or mediastinum and its intensity is similar to its neighbor structures. Thus, we propose a novel segmentation method of lung tumor on chest CT images using asymmetric multi-phase...
deformable model with peripheral region probability map.

Evaluation

Our method has been applied to ten patients with lung tumor. Each CT image had a matrix size of 512 x 512 pixels with in-plain resolutions ranging from 0.52 to 0.73 mm. The slice thickness ranged from 2.5 to 3.0 mm and the number of images per scan ranged from 103 to 158. First, optimal volume circumscribing lung tumor is decided by dragging inside the tumor and initial tumor region was extracted by applying thresholding with threshold value of -400HU to the optimal volume. Second, to estimate the possibility of neighbor structures to be separated from lung tumor, peripheral region probability map is generated. In peripheral region probability map, tumor region is suppressed by localizing lung tumor using Hough ellipse transform and neighbor structure region is highlighted by counting the number of voxels with intensity higher than 0HU. Finally, the initial tumor region is refined by asymmetric multi-phase deformable model with peripheral region probability map. For evaluation of our segmentation method, automatic segmentation results are visually assessed in axial plane and Dice similarity coefficient is measured between automatic and manually segmented tumor regions.

Discussion

Our peripheral region probability map can estimate the possibilities of region to be separated from lung tumor. Our asymmetric multi-phase deformable model with peripheral region probability map can separate lung tumor from attached chest wall and mediastinum without lung segmentation.

CONCLUSION

Our segmentation method can be used in lung tumor measurements for cancer diagnosis, treatment planning and therapy response assessment.

INE021-b

Adding DICOM Segmentation Capability to the National Cancer Informatics Program (NCIP) Annotation and Image Markup (AIM) Enabled Imaging Workstation for Imaging Research (custom application computer demonstration)

Pattanasak Mongkolwat PhD (Presenter): Nothing to Disclose, Vladimir Kleper: Nothing to Disclose, Skip Talbot BS: Nothing to Disclose, Norman Young MSc: President, ClearCanvas Incorporated CEO, ClearCanvas Incorporated, David A. Clunie MBBS: Owner, PixelMed Publishing LLC

Background

For quantitative research and clinical practice, manually authored and automatically generated Regions of Interest (ROIs) may be encoded either as contours or arrays of voxels. The Free Open Source Software AIM-enabled ClearCanvas Workstation creates and displays AIM annotations as DICOM SR or XML. Only contours are stored in AIM annotations. The DICOM Segmentation (SEG) object encodes ROIs as arrays of voxels, and SEG objects may be referenced from AIM annotations (via UIDs). Created SEGs can be consumed by SEG enabled workstations.

Evaluation

SEG capabilities used are sufficient to encode manually created ROIs of unconnected regions on single or successive slices, to make 3D tumor measurements. A shared label is used to identify user-drawn polygonal ROIs to be converted to SEGs. Users select anatomy, category and type properties from an extensive DICOM coded value set, which may be modified via configuration files. A configurable color for each user is recorded. Conformance to the DICOM Segmentation Storage SOP Class was verified mechanically. Creation and display of SEG objects on enhanced multi-frame and series of legacy single frame images is supported and was tested on CT and MR. The workstation loads and superimposes SEGs on referenced images or frames. Binary and thresholded fractional probability or occupancy segments, multiple segments and multiple slices per segment, and sub-regions coplanar with images are supported. Opacity of rendered segments can be adjusted. Correct superimposition and spatial location of sub-regions was verified with synthetic test objects. Computed volume, mean and standard deviation are shown. Statistics of predictable size on imported synthetic test SEG objects were successfully compared with known values.

Discussion

AIM and SEG offer a complete persistence mechanism for 3D ROIs for tumors, serialized as DICOM and compatible with PACS archives. Broader adoption of DICOM SEG in PACS viewers and research tools (3DSlicer, ePad) will also allow interoperable visualization.

CONCLUSION

The workstation allows annotation of imaging features found on images. The new segmentation capabilities make AIM a more powerful tool for clinical and research use.

INE022-b

Big Data in Multiple Sclerosis Analysis: Data Mining and Analysis using a Web-based Longitudinal...
Study Viewer in an Imaging Informatics-based eFolder System (custom application computer demonstration)

Kevin Chikai Ma MS (Presenter): Nothing to Disclose, Ximing Wang MS: Nothing to Disclose, Mark S. Shiroishi MD: Nothing to Disclose, Alexander Lerner MD: Nothing to Disclose, Lilyana Amezcua MD: Consultant, Biogen Idec Inc Consultant, Bayer AG Consultant, Teva Pharmaceutical Industries Ltd Consultant, Merck KGaA Consultant, Pfizer Inc Advisory Board, Biogen Idec Inc Advisory Board, Bayer AG Advisory Board, Teva Pharmaceutical Industries Ltd Advisory Board, Pfizer Inc Advisory Board, Merck KGaA Speaker, Biogen Idec Inc Speaker, Bayer AG Speaker, Teva Pharmaceutical Industries Ltd Speaker, Merck KGaA Speaker, Pfizer Inc

Background

Previously, we have demonstrated a multiple sclerosis eFolder that integrates clinical, imaging, and white matter lesion quantitative data. We have developed a web-based user interface and database to store and view patient data. This year, we aim to fully demonstrate its capability of handling big data analysis and data mining for MS patient treatment and tracking. While data storing and data viewing has been demonstrated before, we will introduce data mining based on patients’ clinical, ethnicity, social and environmental information, and lesion characteristics. Big data analysis results are used to predict MS disease trends and patterns in Hispanic and Caucasian populations. The discovery of disease patterns among the two ethnicities will lead to personalized patient care and treatment planning.

Evaluation

Data from 72 matching Hispanic and Caucasian patients are collected. Quantitative lesion analysis, including lesion volumes, number of lesions, lesion locations, and brain parenchyma ratio, are performed by the CAD program and neuroradiologists. Relationships between disease/lesion progression, treatment types and length of treatments, social and environmental factors, and lesion volumes, sizes, and locations are observed in the two ethnicity groups in the database. The GUI is modified to display patient’s longitudinal image comparisons and lesion tracking across multiple studies to show disease progression with lesion changes, clinical result changes, and symptom progressions.

Discussion

The integrated longitudinal study viewer is successfully demonstrated. Patient profiles have been stored and displayed in the eFolder system. Data analysis has been performed, and different lesion characteristics with ethnic differences of the patients are shown in our pilot study.

CONCLUSION

We have demonstrated how an imaging informatics-based system can handle big data analysis using our MS eFolder, and the system provides data mining, longitudinal disease tracking, monitoring of disease progressions for personalized patient care, and displaying of comprehensive patient profile on a web-based user interface. Results are used to predict MS disease patterns in two different ethnicities from our pilot study.

Does the Background Removal Tool used on Nature Pictures Work Well for Organ Segmentations on 3D CT Images? (custom application computer demonstration)

Xiangrong Zhou PhD: Nothing to Disclose, Takaaki Ito: Nothing to Disclose, Takeshi Hara PhD: Nothing to Disclose, Ryujiro Yokoyama: Nothing to Disclose, Huayue Chen: Nothing to Disclose, Masayuki Kanematsu MD: Nothing to Disclose, Hiroshi Fujita PhD (Presenter): Nothing to Disclose

Background

Background removal is a useful tool that is implemented in Microsoft Office 2010, and can be used to efficiently separate the target (foreground) from the background on a 2D picture. The algorithm of this tool is called "Grabcut" that accomplishes a fast and automatic background removal after marquee selection by indicating a 2D box region. The question whether such kind of background removal techniques work well for organ segmentations on clinical CT image is what we want to answer here.

Evaluation

A dataset consisting of more than 100 volumetric torso CT scans was used for testing. These CT images were generated from 3 kinds of CT scanners from GE, Toshiba, and Philips by using different scan protocols for clinical diagnosis. The spatial resolution of the CT images was varied from 0.62 mm to 2 mm. Nine major organs and tissues including heart, liver, spleen, left-kidney, right-kidney, bladder, gallbladder, left-psosas-major-muscle, and right-psosas-major-muscle were selected as segmentation targets. The Grabcut algorithm was expanded to 3D by our group to adapt to CT images. The Jaccard similarity coefficient (JSC) between the segmentation result and doctors\' manual sketch was used as the accuracy measure.

Discussion

Our evaluation showed that the average JSC values for these targets were in the range of 60 % to 70 %, and can be improved to 90 % by combining with an probabilistic atlas approach. Typical computing time for organ segmentation on a torso CT scan using a general-purpose computer equipped with an Intel Core2Duo 2.23-GHz CPU was less than 1 minute.

CONCLUSION

Background removal technique is helpful for the organ segmentations on CT images, but it was not as powerful as it is used on nature pictures and need to be improved.

Development of Patient Specific Anatomy based 17-segment Modeling (AHA) on Bull’s Eye Map: Application for differentiation between Normal Control and Severe Aortic Stenosis (custom application computer demonstration)

INE024-b
Background

Aortic stenosis is a narrowing of the aortic valve which can cause symptoms and may lead to heart failure. For differentiation between normal control and severe aortic stenosis (AS), we developed cardiac CT quantitative analysis software with patient-specific anatomy based.

Evaluation

An electrocardiogram-gated cardiac CT images was segmented semi-automatically to make patient-specific myocardial 17-segment model (AHA) using seeded region growing method. Two experts manually determined anterior and posterior interventricular groove as a boundary between 1st and 2nd segments and as the other boundary between 3rd and 4th segments respectively to correct the model. Each segment is automatically identified as follows. The outer angle of two boundaries was divided to differentiate 1st, 4th, 5th and 6th segments with basal plane while the inner angle divided 2nd and 3rd segments. Similarly, segments of mid plane are differentiated. The area of the 17 segments was quantitatively assessed on the bull’s eye map using the morphological boundaries. For this procedure, an in-house program was developed on the windows7 x64 environment. CT data (normal control: 35, AS: 144) were evaluated for bull’s eye map analysis. Segment area distributions of AS patients and normal control were significantly different (t-test, all p-values < 0.011) which would be equivalent to maximum thickness of each segment in 3D (t-test, all p-values < 0.02 except 5th segment). In addition, quantitative parameters including mean density, maximum thickness and volume of each segment were structured-reported in this platform.

Discussion

This patient-specific anatomy based 17-segment model could be used for differentiate between AS and normal control. Especially, this model could be equivalent to 3D segment analysis and would be superior to conventional 17-segment model, because it represents patient-specific segment anatomy information simultaneously on the bull’s eye map with visualization of morphological boundaries.

CONCLUSION

We developed the quantitative cardiac analysis platform with 17-segment considering anatomic variation. These quantification parameters could be used for differentiate AS and normal control using cardiac CT scans.
CONCLUSION

[T68Ga]DOTATOC and [68Ga]DOTANOC uptake and binding to sstr2 in HGG is highly dependant on BBB disruption evaluated by T1gad on MRI. However, tracer uptake cannot be predicted by sstr2 immunohistochemistry which together with relatively low tumor SUVmax suggests limited feasibility of HGG to sstr2 targeted radionuclide therapy.

CLINICAL RELEVANCE/APPLICATION

Sstr2 expression in HGG corresponds to biomarkers associated with favorable prognosis. However, sstr2 expression in HGG cannot be predicted by [68Ga]DOTATOC or [68Ga]DOTANOC PET/CT.

Role of F-18 FDG PET-CT in Assessment of Patients with Suspected Infection or Inflammatory Conditions (Station #10)

Sikandar Mohd Shaikh DMRD (Presenter): Nothing to Disclose

PURPOSE

The objective of this study was to highlight the clinical significance and role of FDG PET-CT in assessment of patients with suspected infection or inflammatory condition.

METHOD AND MATERIALS

A total of 22 pts (59.6 ± 15.1 years old, M/F=14/8) with suspected infection and inflammatory condition from clinical manifestations and blood tests were retrospectively studied. FDG PET-CT was performed on these patients to localize infection or inflammatory sites. PET-CT findings were evaluated in relation to results of blood tests (C-reactive protein (CRP), white blood cell count (WBC)), treatment, and prognosis.

RESULTS

5 pts (22.7%) showed negative findings on FDG PET-CT. All these patients recovered with conservative antibiotic treatment and favorable prognosis except one patient (one with viral encephalitis who had severe neurological sequelae ). 16 pts (75%) showed positive findings suggesting infection or inflammation in various regions: bone and soft tissue, 4; colon, 2; mediastinum, 2; lung, 2; heart and pericardium, 2; retroperitoneum, 1; gall bladder, 1; kidney, 1; vascular graft, 1. One patient (2.3%) showed positive finding suggesting not infection but malignant lymphoma and was diagnosed with diffuse large B cell lymphoma subsequently. In PET-positive pts, surgical treatments, abscess drainage, or removal of pace maker lead were done in 5 pts. In PET positive patients 2 pts had died due to multiple organ failure, Remaining 15 pts recovered by appropriate surgical and medical treatment. In PET-negative and PET-positive pts, CRP (mg/dl) was 9.0±9.0 and 8.6±7.6, WBC (/μl) was 8600±3300 and 10000±6600, showing no significant difference.

CONCLUSION

FDG PET-CT was useful in initial assessment of patients with suspected infection or inflammatory condition, providing important information regarding location and severity of the disease. PET-negative pts tended to have mild disease however, presence of PET-negative severe disease such as viral encephalitis should be kept in mind.

CLINICAL RELEVANCE/APPLICATION

Thus FDG PET-CT is important tool in diagnosing the many infective foci in the body.
To quantitatively evaluate nerve roots by measuring fractional anisotropy (FA) values in healthy volunteers and sciatica patients, visualize nerve roots by tractography, and compare the diagnostic efficacy between conventional magnetic resonance imaging (MRI) and DTI.

METHOD AND MATERIALS
Seventy-five sciatica patients and thirty-six healthy volunteers underwent MR imaging using DTI. FA values for L5-S1 lumbar nerve roots were calculated at three levels from DTI images. Tractography was performed on L3-S1 nerve roots. ROC analysis was performed for Pfirrmann grade and FA values.

RESULTS
The lumbar nerve roots were visualized and FA values were calculated in all subjects. FA values decreased in compressed nerve roots and declined from proximal to distal along the compressed nerve tracts. Mean FA values were more sensitive and specific than MR imaging for differentiating compressed nerve roots, especially in the far lateral zone at distal nerves.

CONCLUSION
DTI can quantitatively evaluate compressed nerve roots, and DTT enables visualization of abnormal nerve tracts, providing vivid anatomic information and localization of probable nerve compression. DTI has great potential utility for evaluating lumbar nerve compression in sciatica.

CLINICAL RELEVANCE/APPLICATION
DTI is able to quantitatively evaluate compressed nerve roots and has a higher sensitivity and specificity for diagnosing sciatica than conventional MR imaging. Additionally, DTT enables visualization of abnormal nerve tracts, providing vivid anatomic information and probable localization of nerve compression.

Diffusion-weighted MR Neurography of Nerves in Wrist and Palm and the Initial Clinical Applications (Station #2)
Shanshan Wang (Presenter): Nothing to Disclose, Guangbin Wang MD: Nothing to Disclose

PURPOSE
To demonstrate the feasibility of diffusion-weighted (DW) magnetic resonance (MR) neurography of nerves in wrist and palm and evaluate the potential clinical applications

METHOD AND MATERIALS
This study was approved by local institutional review board, and informed consent was obtained. Total forty-two healthy volunteers and seven patients underwent DW MR neurography of nerves in wrist and palm at a 3.0-T magnetic resonance system. DW MR neurography images were displayed using a three-dimensional (3D) maximum intensity projection and blindly evaluated by two radiologists in consensus using a four-point grading scale (1 = poor [the nerves were twisted seriously, and recognized difficultly]; 2 = moderate [the nerves were twisted but the branches can be recognized]; 3 = good [the branches were displayed clearly, ill-defined margin]; 4 = excellent [the branches were displayed clearly, well-defined margin]). In patients, the relation of the lesion to adjacent nerves were evaluated.

RESULTS
The trajectory of median and ulnar nerve in wrist, the branches of median nerve including the lateral and medial portion and three proper volar digital nerves, superficial and deep branches of ulnar nerve could be visualized on DW MR neurography images. In volunteers, image quality of nerves in wrist and palm was all graded as excellent. The mean score of all nerves and their branches were 3.45±0.74 and 3.43±0.67 for observers 1 and 2, respectively. Interobserver agreement was good (κ=0.793). In patients, there was no discrepancy in imaging quality scores between observers. Scores of all nerves were 2-4. The extent of lesions and the relationship with nerves were displayed clearly on DW-MRN images of 7 patients.

CONCLUSION
DW MR neurography is feasible for providing three-dimensional visualization of median and ulnar nerves and their main branches in wrist and palm. Our preliminary results suggest that the use of DW MR neurography, as complementary to conventional MR imaging, may enable nerve depiction and allow assessment of the anatomic relationship between lesions with diffusion restriction and adjacent nerves.

CLINICAL RELEVANCE/APPLICATION
DW MR neurography may enable nerve depiction in wrist and palm and allow assessment of the anatomic relationship between lesions and adjacent nerves

Efficacy of Diffusion-weighted MRI in Diagnosing Spinal Root Disorders in Lumbar Disc Herniation (Station #3)
Hiroyuki Takashima PhD (Presenter): Nothing to Disclose, Tsuneo Takebayashi MD, PhD: Nothing to Disclose

MKS366
MKS367
PURPOSE
In this study, we captured diffusion-weighted imaging (DWI) of dorsal root ganglion (DRG) of the affected nerve root in lumbar disc herniation and examined the relationship between apparent diffusion coefficient (ADC) and clinical symptoms to evaluate the efficacy of DWI in the diagnosis of lumbar spinal disorders.

METHOD AND MATERIALS
The subjects were patients who underwent surgical management of unilateral radiculopathy caused by a single level lumbar disc herniation where the affected nerve root could be easily identified. The clinical symptoms of all the subjects (total 30; 19 males, 11 females; average age: 44.3 ± 15.5 years) were consistent with the imaging findings. We analyzed the relationship between morbidity duration, Visual analogue scale (VAS) score, and ADC. In addition, we investigated any correlation between the improvement rate of VAS before and after surgery with ADC.

RESULTS
When compared to the contralateral intact side, ADC of the affected nerve root was observed to increase in 18 subjects and decrease in 12 subjects and thus no definite trend were observed. In cases showing a decrease in ADC on the affected side, the VAS recovery ratio was low, suggesting that patients with decreased ADC tended to show poor improvement of leg symptoms.

CONCLUSION
This study showed that patients with decreased ADC tended to show poor improvement of leg symptoms, which may suggest the possibility that ADC of DRG is related to neuronal plasticity.

CLINICAL RELEVANCE/APPLICATION
The evaluation of DRG using ADC calculated from the DWI data may be available for a variety of spinal disorders such as lumbar spinal stenosis.

Increased Signal Intensity at the Proximal Patellar Tendon: MR Imaging-Histologic Correlation in Five Cadavers and MR Imaging Studies of 84 Patients (Station #4)
Seong Jong Yun (Presenter): Nothing to Disclose, Wook Jin: Nothing to Disclose, Gou Young Kim MD, PhD: Nothing to Disclose, Yong Koo Park MD, PhD: Nothing to Disclose, Woo Jin Yang: Nothing to Disclose, Kyung Jin Lee: Nothing to Disclose, So Young Park MD, PhD: Nothing to Disclose, Ji Seon Park MD, PhD: Nothing to Disclose, Kyung Nam Ryu MD, PhD: Nothing to Disclose

PURPOSE
During evaluation of the knee MR images, we can often observe increased signal intensity (SI) in the posterior portion of the proximal patellar tendon (PT) on T1-weighted images (T1WI), which shows no signal suppression on fat-suppressed sequences. Therefore, we correlated the MR findings with the histologic findings in 5 cadavers to investigate the cause of signal change, and also retrospectively evaluated SI of the PTs in 84 patients.

METHOD AND MATERIALS
MR imaging was performed in 5 cadavers followed by gross histologic correlation. To compare SI of the PTs, 84 patients (31 men, 53 women) without trauma history and anterior knee pain were included in this study. Length and thickness of increased SI portion in the proximal PT on T1WI were recorded and we divided these 84 patients into 3 groups as follows; between 20 and 39 years old (group 1, n = 21), between 40 and 59 years old (group 2, n = 37), and above 60 years old (group 3, n = 26). Demographic characteristics, length, and thickness of the PTs of the 84 patients were also recorded and compared in the 3 groups.

RESULTS
Histologic specimens of 5 cadavers showed the fat, vessels, and connective tissue invaginating into the posterior portion of the proximal PT, corresponding to signal change of the tendon on MR imaging. Linear increased SI of proximal PT was seen in all of 84 patients (100%) on T1WI. There were no differences in length and thickness of increased SI portion among the 3 groups (p > 0.05). No differences in demographic characteristics, length, and thickness of the PTs were also found among the 3 groups (p > 0.05).

CONCLUSION
On T1WI and fluid-sensitive MR images, a normal PT can present linear increased SI without any disease process, which results from invaginating intratendinous fat, vessels, and connective tissue. It was not related to the age, sex, and size of the PT. Therefore, this might be a normal finding without clinical significance.
The linear increased SI of proximal PT on T1WI and fluid-sensitive MR images is not a pathologic or degenerative condition, but a common normal finding.

**Correlation between BMD Measurements on Unenhanced Routine CT Scans Using a Phantom-less Measurement Tool and the 10-year Fracture Probability Calculated by FRAX® (Station #6)**

**PURPOSE**

To evaluate the correlation between bone mineral density (BMD) measurements on unenhanced, routine CT scans using a phantom-less measurement tool and the 10-year fracture probability calculated by the FRAX® tool. In addition, the ability to identify a potentially aggravated fracture risk using this measurement tool was investigated.

**METHOD AND MATERIALS**

Seventy-seven postmenopausal women (mean age: 57.2 years), who underwent a routine, unenhanced CT scan, were included. The mean BMD value of each patient, including the Th12 - L4 vertebrae, was calculated retrospectively using a commercially available phantom-less measurement tool. Exclusion criteria were vertebral fractures, and sclerotic or osteolytic bone lesions. A minimum of two measurable vertebrae was required. In addition, the patient's 10-year probability of a major osteoporotic fracture and of a hip fracture were calculated using the FRAX® tool without including DXA-BMD values.

**RESULTS**

Mean BMD values of patients with a 10-year probability of a major osteoporotic fracture ≥5% differed significantly compared to patients with a FRAX® score <5% (mean BMD value ≥5%: 59.13 mg/cm³; <5%: 83.32 mg/cm³; t=-3.460, p=0.001). Phantom-less BMD measurements correlated significantly (p<0.001) with the fracture risk evaluated by FRAX® (Pearson correlation coefficient: major osteoporotic fracture risk R=-0.526, hip fracture risk R=-0.464). With a threshold of about 70 mg/cm³, the sensitivity was 75%, with a false-positive rate of 36.8%. However, with a threshold of about 80 mg/cm³ the sensitivity was 80% and the false-positive rate raised up to 50.9%. The intra-rater agreement of BMD measurements was calculated with an ICC of 0.986, and the inter-observer reliability was calculated with an ICC of 0.987.

**CONCLUSION**

An increased fracture risk can be diagnosed as an additive finding on routine CT scans, without additional radiation exposure, by using a phantom-less tool. Patients with a decreased BMD value should be further evaluated using the FRAX® 10-year fracture probability calculation.

**CLINICAL RELEVANCE/APPLICATION**

Patients with a decreased BMD value, measured with a phantom-less tool on routine CT scans, may benefit from an additional calculation of the FRAX® score to predict osteoporotic bone conditions.

**Inferior Glenohumeral Ligamentous (IGHL) Complex - Anatomy, Injuries, and Adhesive Capsulitis (Station #8)**

**TEACHING POINTS**

The purpose of this exhibit is to educate the radiologist about the clinical presentation, basic pathophysiology, imaging findings, differential diagnosis, and relevant clinical management for Inferior Glenohumeral Ligamentous (IGHL) complex injuries and related pathologies. The reader will be walked through an anatomic refresher followed by a series of imaging based cases demonstrating key findings in the variants of IGHL injury and adhesive capsulitis using various imaging modalities and illustrations.

**TABLE OF CONTENTS/OUTLINE**

- Pictorial and imaging anatomy of the glenohumeral joint and IGHL complex (anterior and posterior bands and interposed axillary pouch)
- Mechanism of injury and clinical presentation of specific IGHL pathology
- Pictorial presentation of variations of IGHL injuries (HAGL, BHAGL, GAGL, RHAGL, AIGHL, and axillary pouch tears)
- Radiological imaging cases of all of the discussed IGHL injury variants -Management of IGHL injuries
- Adhesive capsulitis: clinical presentation, etiology, imaging findings, staging, grading, case examples, and treatment options
- References

**Fly through the Joint - Virtual Arthroscopy of the Shoulder Using CT Arthrogram (Station #9)**

**TEACHING POINTS**

While the purpose of this exhibit is to educate the radiologist about the clinical presentation, basic pathophysiology, imaging findings, differential diagnosis, and relevant clinical management for the Inferior Glenohumeral Ligamentous (IGHL) complex injuries and related pathologies. The reader will be walked through an anatomic refresher followed by a series of imaging based cases demonstrating key findings in the variants of IGHL injury and adhesive capsulitis using various imaging modalities and illustrations.

**TABLE OF CONTENTS/OUTLINE**

- Pictorial and imaging anatomy of the glenohumeral joint and IGHL complex (anterior and posterior bands and interposed axillary pouch)
- Mechanism of injury and clinical presentation of specific IGHL pathology
- Pictorial presentation of variations of IGHL injuries (HAGL, BHAGL, GAGL, RHAGL, AIGHL, and axillary pouch tears)
- Radiological imaging cases of all of the discussed IGHL injury variants -Management of IGHL injuries
- Adhesive capsulitis: clinical presentation, etiology, imaging findings, staging, grading, case examples, and treatment options
- References
TEACHING POINTS

1. Similar to 3D simulated "fly through" in CT colonography and Virtual Bronchoscopy, learn the virtual arthroscopy protocol as applied to 3D CT arthrogram.
2. Gain knowledge of normal anatomy of the shoulder on virtual arthroscopy.
3. Learn surface rendered imaging appearances of synovial thickening, cartilage abrasions, bankart lesion and labral pathology.

TABLE OF CONTENTS/OUTLINE

1. Introduction to 3D "fly through" and surface rendering technique on stand alone work station, TeraRecon.
2. Normal anatomical appearances of the shoulder on virtual arthroscopy.
3. Case examples of synovial, labral, cartilage and bankart lesions on virtual arthroscopy with relevant direct arthroscopy correlation.
4. Advantages and disadvantages of virtual arthroscopy will be highlighted.

Secrets of the Periosteum: Clues to Underlying Osseous and Metabolic Diseases (Station #10)
Chuanxing Qu MD (Presenter): Nothing to Disclose, Cynthia Ann Britton MD: Nothing to Disclose

TEACHING POINTS

1. Review the anatomy, physiology and function of the periosteum.
2. Emphasize the importance of analysis of the periosteum on CR, as well as CT and MRI imaging, and its relationship to underlying osseous and metabolic disease processes which may impact clinical management.

TABLE OF CONTENTS/OUTLINE

1. Discuss the anatomy, physiology and function of the periosteum.
2. Present a method for systematic analysis of the periosteum, in particular in CR imaging, as well as CT and MR, with regards to appearance, location within a particular osseous structure and distribution within the skeleton.
3. Provide a differential based on the above analysis to permit identification of underlying osseous disease or identification of a more wide-spread metabolic process. Specifics examples of HPOA, SAPHO, thyroid acropachy, flucanazole-related periostitis, Ewings, osteosarcoma, metastatic disease and cortical-based osteoid osteoma will be demonstrated.

Schematic Approach to MRI Diagnosis of Inherited Muscle Diseases Based on Clinical Signs and Categorization (Station #11)
Ahmed Wafaie (Presenter): Nothing to Disclose, Hassan Kassem MD: Nothing to Disclose, Ahmed Aboumousa: Nothing to Disclose

TEACHING POINTS

1. To learn how to approach a reliable MR diagnosis (or even a short list of differential diagnosis) of inherited muscle diseases based on clinical signs and categorization.
2. Suggested MR grading system to describe muscle involvement will be displayed as the diagnosis depends on selective involvement of certain muscles and sparing of others.
3. To gain an awareness of the clinical categorization of inherited muscle diseases and different clinical signs that will reinforce the confidence in MR diagnosis.
4. To display a wide variety of original work cases.

- Introduction about inherited muscle diseases
- The clinical categorization used as a frame for MR diagnosis (each has different group of diseases) which is:
1- Limb girdle muscle dystrophy with calf hypertrophy
2- Limb girdle muscle dystrophy with calf atrophy
3- Early onset myopathy
4- Myopathy with distinctive clinical manifestations
- The MR examination protocol for thighs and legs
- The MR grading system for muscle involvement to describe which muscles are affected more than others and which are spared
- How to reach a reliable diagnosis based on the predescribed pattern of muscular involvement in literature for each disease under certain clinical category?

Bone Marrow Signal Changes on MRI: What Is Normal? (Station #12)
Filippo Del Grande MD, MBA (Presenter): Nothing to Disclose, Laura Marie Fayad MD: Nothing to Disclose

TEACHING POINTS

1) There are a number of techniques available by MRI to differentiate normal red marrow interspersed with fatty marrow from bone marrow lesions.
2) Patterns in bone marrow signal changes by MRI are helpful for guiding the diagnosis towards marrow-replacing tumors, and differentiating stress reactions, osteomyelitis and arthropathy-related lesions.
3) Although T1 spin echo is vital to the characterization of bone marrow signal abnormalities, additional techniques, including chemical shift imaging, diffusion weighted imaging and perfusion imaging can be helpful for assessing bone marrow signal abnormalities.

TABLE OF CONTENTS/OUTLINE
Normal bone marrow Basic principles of normal bone marrow composition and physiological bone marrow reconversion. Review of MRI techniques and technical considerations for imaging the bone marrow Conventional noncontrast sequences: T1 weighted, T2 weighted, chemical shift imaging Functional sequences: diffusion weighted imaging, contrast enhanced dynamic and static sequences Differentiating features of bone marrow abnormalities Tumors, stress-related injuries, infection, arthropathy-related signal changes Important pitfalls in assessing bone marrow signal changes Main pitfalls will be highlighted

MKE198

"Oh!! Snap It ....." Dynamic Ultrasound of Snapping Syndromes (Station #13)
Srinadh Boppana MD (Presenter): Nothing to Disclose, Eshwar Chandra Nandury MD: Nothing to Disclose, Krishna Subrahmanyam MS: Nothing to Disclose, Jyothi Reddy MD: Nothing to Disclose, Annapurna Sriramabhatla MD: Nothing to Disclose, Balaji Varaprasad Mallula MD: Nothing to Disclose, Prashanth Kumar Karnati MD: Nothing to Disclose

TEACHING POINTS
Throw light on various snapping syndromes in the body
Usefulness of dynamic ultrasound in comprehensively evaluating these pathologies with emphasis on positioning and technique

TABLE OF CONTENTS/OUTLINE
Introduction Ultrasound positioning and technique at various anatomical levels Snapping syndromes Scapular snapping Snapping of biceps tendon Trigger finger Snapping of ulnar nerve Internal and external snapping of hip Medial collateral ligament snapping over surgical screws. Peroneal tendon snapping Conclusion

MKE023-b

MR Artifacts in Musculoskeletal Imaging: Simple and Easy Method to Overcome (hardcopy backboard)
Kyu Young Lim (Presenter): Nothing to Disclose, Dong Ho Ha: Nothing to Disclose, Sunseob Chol MD, PhD: Nothing to Disclose, Jin Hwa Lee MD: Nothing to Disclose, Eun Ju Kang MD: Nothing to Disclose

TEACHING POINTS
The educational objectives of this article are to describe the common magnetic resonance imaging (MRI) artifacts in musculoskeletal imaging and to provide simple and easy solution with image-based explanation.

TABLE OF CONTENTS/OUTLINE
CONTENT ORGANIZATION 1. To illustrate the various MR artifacts that correlated with field inhomogeneity, the off center position, high resolution image for small joints, fat-suppression techniques, metal and flow, etc. 2. To describe simple and easy methods to overcome, including reposition into near iso-center, using insensitive sequences, swapping encoding directions and changing of voxel size, etc. Conclusion Understanding the easy and simple methods to overcome MR artifacts allows radiologists to improve the image quality and can make more confident diagnosis.

MSE-TUA

Multisystem/Special Interest Tuesday Poster Discussions

Education Exhibits

OT
AMA PRA Category 1 Credits ™: .50
Tue, Dec 2 12:15 PM - 12:45 PM Location: MS Community, Learning Center

Sub-Events

MSE139

Hydatid Disease: Spectrum of Unusual Locations and Complications (Station #1)
Badreedine Alami MD (Presenter): Nothing to Disclose, Omar Addou MD, MSc: Nothing to Disclose, Youssef Alaoui Lamrani MD: Nothing to Disclose, Imane Kamaoui MD, PhD: Nothing to Disclose, Siham Tiznitii: Nothing to Disclose, Mustapha Maaroufi: Nothing to Disclose, Meryem Boubbou: Nothing to Disclose

TEACHING POINTS
- Describe the imaging features of hydatid disease in various unusual locations. - Recognize the appropriate imaging methods for each location, its advantages and limitations. - Show the various complications of this infectious process.

TABLE OF CONTENTS/OUTLINE
CONTENT ORGANIZATION 1) Introduction 2) Epidemiology and etiopathogeny 3) Imaging tools: Plain radiography, ultrasonography, computed tomography (CT) and MR imaging 4) Specific radiologic appearance in unusual sites including: Spleen - Kidney - Pancreas- Adrenal gland - Peritoneum and retroperitoneum - Interventricular septum - Pleura- Diaphragmatic crus - pulmonary artery - Brain - Spinal cord - Soft tissue- Testis and Ovary. 5) Complications of hydatid disease including: - Rupture and biliary communication,
Bacterial superinfection of hydatid cyst, Exophytic growth, Perforation into hollow viscera, Peritoneal seeding, Portal vein involvement, Abdominal wall invasion. SUMMARY The hydatid disease should be included in the differential diagnosis of a cystic lesion, found anywhere in the body, especially when they occur in endemic regions. Good knowledge of unusual locations and its imaging findings is essential to make a prompt and accurate diagnosis and avoid serious complications of this infectious process.

**MSE121**

The Post-Visceral Transplant Neoplasias: A Review (Station #2)


**TEACHING POINTS**

**PURPOSE/AIM**

1. Review epidemiology and prognosis of post-transplant malignancy
2. Review risk factors and potential predictors of malignancy
3. Review imaging findings of post-transplant malignancies

**TABLE OF CONTENTS/OUTLINE**

CONTENT ORGANIZATION
1. Epidemiology, characteristics and prognosis of post-transplant malignancy
   a. Epidemiology and common tumors
   b. Survival comparison to non-transplant patients
2. Risk factors and predictors of malignancy
   a. Risk factors for solid organ malignancies
   b. Risk factors for non-melanoma skin cancers
   c. Role of immunosuppressive therapy and viral infections
3. Cross-sectional imaging of post-transplant tumors
   a. Donor organ and recipient preexisting malignancies
   b. De novo malignancies
      i. Kaposi’s sarcoma
      ii. Post transplant lymphoproliferative disorder
      iii. Skin tumors
      iv. Others
4. Conclusion

SUMMARY As mortality from infectious and cardiovascular diseases decline, malignancy has become one of the more common causes of morbidity and mortality in transplant patients. Malignancies in these patients carry worse prognosis. Long term immunosuppression and viral illness are the most important of risk factors and predictors. The purpose of this exhibit is to illustrate the pathophysiology, risk factors, and role of imaging in screening and diagnosing post-transplant malignancies.

**Nuclear Medicine Tuesday Poster Discussions**

Scientific Posters

NMS-TUA

**NMS168**

The Importance of Increased 18F-FDG Uptake in Dominant Thalamus for Functional Improvement from Chronic Traumatic Brain Injury (Station #1)

Yoshio Uchino MD, PhD (Presenter): Nothing to Disclose

**PURPOSE**

In patients with chronic severe traumatic brain injury (cs-TBI), it is believed that outcomes can be very poor. However, functional improvement was observed in some patients even in a few years after the injury. We studied the changes of brain 18F-FDG uptake and functional improvement of the patients with cs-TBI.

**METHOD AND MATERIALS**

Sixty-eight patients with cs-TBI (6 months or more after injury, ranging from 17 to 74 years (39±14, mean±SD)) underwent brain FDG-PET twice on admission and after 22 months. The rate of functional improvement on the CHIBA score (vegetative and minimally conscious state, range, 0 to 100, with the lower scores indicating greater disability) was compared over 22 months almost at the same time with each FDG-PET scan. The cases were divided into 2 groups on the basis of the score, those were 51 cases with recovery in score less than 5 points (un-improved group), and 17 cases with recovery in score 5 points or more (improved group). Volumes of interests (VOIs) were placed on bilateral thalamus (Th) and whole brain (WB), and each average standardized uptake values (SUVs) were obtained from each 1st and 2nd PET. We examined the factors influencing functional improvement in patients with cs-TBI.

**RESULTS**

In the un-improved group, the SUVs of right Th and WB were significantly increased (both p<0.05) but left Th have not changed between two scans (p=0.39), while in the improved group, SUVs have increased in bilateral Th and WB (p<0.05 for all). Multivariate logistic regression analysis identified higher uptake of left thalamus at the 1st PET, higher increase of uptake in left thalamus between 1st and 2nd PET, and the shorter durations after injury as factors associated with functional improvement.
CONCLUSION
Increased FDG uptake in dominant thalamus is important for the functional improvement from chronic severe traumatic brain injury. Preservation of dominant thalamus is the key for functional improvement. Even in the chronic stage, improvement can be expected in certain cases by careful medical treatment.

CLINICAL RELEVANCE/APPLICATION
For the patients in the chronic severe traumatic brain injury, brain FDG-PET is useful for objective evaluation of functional improvement.

Impact of Attenuation Correction and Inter-rater Reliability on Quantitative 123I-ioflupane Brain SPECT (Station #2)
Kaveh Vejdani MD (Presenter): Nothing to Disclose, Razi Muzaffar DO: Nothing to Disclose, Medhat M. Osman MD: Speaker, Koninklijke Philips NV, Hannah Sweet: Nothing to Disclose, Harsh C Gandhi BS,MSc : Nothing to Disclose

PURPOSE
To examine the effect of CT attenuation correction on quantitation and visual semi-quantitative interpretation of DaTscan (123I-ioflupane) brain SPECT images; and to evaluate inter-rater reliability in 123I-ioflupane (DaTscan) brain SPECT image processing.

METHOD AND MATERIALS
123I-ioflupane (DaTscan) brain SPECT and SPECT/CT images from 21 patients were analyzed retrospectively. Axial reconstruction was performed with and without attenuation correction (AC and NAC respectively). On each of the AC and NAC stack, axial slices passing through the striatum were summed into a representative image. Ioflupane uptake in bilateral striata was quantified using manually drawn regions of interest (ROI). The occipital lobes were used as background for specific binding ratio (SBR) calculation. SBR was defined as striatal counts minus background counts, divided by background counts. SBR values and percent SBR asymmetry were compared between AC and NAC images. Ioflupane visual uptake level (VUL) in bilateral striata was graded on a scale of 0 to 5 and was correlated with SBR on both AC and NAC images.

RESULTS
Striatal SBR values were significantly different (table 1) between AC and NAC images (p<0.001) but SBR asymmetry was not significantly different (p = 0.73). Visual estimation of striatal Ioflupane uptake (VUL) correlated moderately (r2 <0.7) with SBR (table 1). There was a high inter-rater reliability (r2 > 0.7) of SBR measurements (table 1).

CONCLUSION
CT AC significantly affects striatal ioflupane uptake measurement and yields higher SBR values. However, the degree of SBR asymmetry does not seem to be significantly affected by AC. Visual estimation of striatal ioflupane uptake does not correlate strongly with SBR. Quantitative SBR measurement with manual regions of interest is reproducible between two measurements.

CLINICAL RELEVANCE/APPLICATION
Using attenuation correction for 123I-ioflupane brain SPECT has been recommended in the nuclear medicine community but its impact on quantitative assessment of the imaging remained unknown.

Alteration Patterns of Brain Glucose Metabolism: Comparisons of Subjective Memory Impairment, Mild Cognitive Impairment and Healthy Controls (Station #3)
So Hwa Yoon (Presenter): Nothing to Disclose, Yong-An Chung MD, PhD : Nothing to Disclose, In Uk Song : Nothing to Disclose, Kijun Kim : Nothing to Disclose, Jin Kyung Oh MD : Nothing to Disclose

PURPOSE
Recent clinical and research interests have focused on mild cognitive impairment (MCI) as a prodrome of Alzheimer’s disease (AD) in the prevention of clinical progression. Moreover, some groups have focused on the detection and management of subjective memory impairment (SMI) as the stage that precedes MCI. However, there have been few clinical studies that have examined biomarkers of SMI to date. Therefore, in this study we investigated differences in glucose metabolism as a prodromal marker of dementia in patients with SMI, MCI, and healthy controls using brain FDG-PET.

METHOD AND MATERIALS
We recruited 68 consecutive patients with SMI, 47 patients with MCI, and 42 age-matched healthy subjects. All subjects underwent FDG-PET and detailed neuropsychological testing. FDG-PET images were analyzed using the SPM program.

RESULTS
FDG-PET analysis showed reduced glucose metabolism in the periventricular regions of patients with SMI and in
the parietal, precentral frontal, and periventricular regions of patients with MCI compared with healthy controls. Interestingly, hypometabolism on FDG-PET was noted in the parietal and precentral frontal regions in MCI patients compared to SMI patients.

CONCLUSION

Our results suggest that hypometabolism in the periventricular regions as seen on FDG-PET may play a role as a predictive biomarker of pre-dementia, and the extension of reduced glucose metabolism into parietal regions likely reflects progression of cognitive decline.

CLINICAL RELEVANCE/APPLICATION

We investigated differences in glucose metabolism in patients with SMI, MCI, and healthy controls using brain FDG-PET as a potential prodromal biomarker of progression to dementia. An early, accurate diagnosis of prodromal dementia may be valuable since it could allow for proper management and prevent progression to dementia.

NMS171

Prospective Multicentre Analysis of 18F-FDG PET-CT in the Management of Fever of Unknown Origin (FUO) (Station #4)


PURPOSE

18F-FDG PET-CT plays an important role in the management of fever of unknown origin. FUO is defined as "body core temperature more than 38.3°C on several occasions lasting for more than three weeks but no cause found despite routine clinical investigations for more than a week in hospital". The aim of this study is to analyze the diagnostic performance of PET-CT in patients with FUO.

METHOD AND MATERIALS

231 consecutive patients with FUO in two hospitals were prospectively studied using PET-CT after negative conventional clinical/radiological investigations. Final diagnosis was based on biopsy, microbiological tests and imaging follow-up. Patients' haematological/biochemical results were also recorded.

RESULTS

The cause of FUO was identified only in 129/231 (56%) patients: infection in 51, malignancy in 27, non-infectious inflammatory diseases in 41 and other causes in 10. PET-CT was True Positive in 98/231 patients: infection in 48, malignancy in 22, inflammation in 28. False Positive in 18/231 patients, due to increased FDG-uptake in reactive nodes. False Negative in 31/231 patients: infection in 3, malignancy in 5, inflammation in 13, others in 10. PET-CT misses connective tissue diseases and non-FDG-avid or poorly-FDG-avid malignancy, or infection within the organs of normal physiological FDG-uptake such as brain and liver. The PPV, NPV and accuracy of PET-CT were 84%, 73% and 79%. On multivariate analysis none of the inflammatory markers (WCC, ESR and CRP) statistically satisfied as independent predictor of PET-positivity.

CONCLUSION

PET-CT correctly demonstrated or excluded a cause in 79% of FUO patients. A negative PET-CT with no spontaneous recovery still requires further investigations in order to exclude sinister causes such as myeloma and small gastrointestinal/renal/pancreatic malignancies, although it could take up to a month to reach final diagnosis. Spontaneous recovery also could take more than a month after hospital admission.

CLINICAL RELEVANCE/APPLICATION

18F-FDG PET-CT plays an important role in the management of FUO, identifying or excluding causes in 79% of FUO patients. The remaining 21% still require further investigations if spontaneous recovery not achieved.

NMS172

The Usefulness of Volume Based Parameters (MTV or TLG) of Methionine PET in Brain Tumor—Comparison Study with FDG-PET/CT (Station #5)

Shigeki Nagamachi MD, PhD (Presenter): Nothing to Disclose, Ryuichi Nishii MD, PhD: Nothing to Disclose, Youichi Mizutani: Nothing to Disclose, Seigo Fujita MD: Nothing to Disclose, Takanori Yano MD, PhD: Nothing to Disclose, Shozo Tamura MD, PhD: Nothing to Disclose

PURPOSE

Methionine-PET is recommended in diagnosing brain tumors because of better tumor contrast than FDG-PET. However, commonly used quantitative parameter such as SUVmax shows lower values and narrower ranges compared with that of FDG. In addition, SUVmax reflect only the value of the single voxel and it does not reflect a whole tumor image. Although the utility of metabolic tumor volume (MTV) and total lesion glycolysis (TLG) in the quantitative evaluation is reported in FDG, there have been no reports regarding the methionine (MET). We compared the values of quantitative parameters between MET-PET and FDG—PET in brain tumors.

METHOD AND MATERIALS

In 21 cases of brain tumor (Glioblastoma14, Oligodendroglioma4, Malignant lymphoma 2, Dysgerminoma1), we
compared the values of methionine uptake parameters with those of FDG uptake parameters and also examined the correlation of both parameters. In calculating the volume based parameters, the threshold was 40% of SUVmax. In order to avoid the influence of physiological brain uptake, voxel of interest was drawn on the three-dimensional PET/MRI fusion image. The parameter of methionine PET which corresponds to TLG of FDG-PET, we defined it as Total lesion methionine metabolism (TLMM). Both comparisons and correlations of parameters between the both examinations were analyzed.

RESULTS

Both values of SUVmax and SUVpeak were significantly lower in MET compared with those of FDG (3.74 vs. 8.72 and 3.33 vs.6.86). In contrast, both values of MTV and TLMN (TLG) were significantly higher in MET compared with those of FDG (44.98ml vs. 21.52ml and 83.88 vs. 44.37). In the correlation analysis, both volume based parameters showed good correlation compared with those of SUVmax or SUVpeak (MTV: 0.78, TLG: 0.73, SUVmax: 0.4, SUVpeak: 0.32). Thus both volume-based parameters demonstrated appropriate quantitative values and also showed good correlation to those of FDG-PET parameters.

CONCLUSION

In evaluating brain tumor quantitatively by MET-PET, volume based parameter, particularly MTV, was considered to be the most relevant parameter.

CLINICAL RELEVANCE/APPLICATION

Although the MET-PET is useful in evaluating brain tumor, ideal quantitative parameter had not been available. The current study demonstrated that volume based parameters were applicable for diagnosing brain tumor.

NME113

**Added Value of FDG PET/MRI Compared with PET/CT in Patients with Colorectal Cancer and Workflow Solutions for PET/MRI Examination (Station #6)**

Nghi Co Nguyen MD, PhD : Research Grant, Koninklijke Philips NV , Peter F. Faulhaber MD : Speaker, Koninklijke Philips NV Grant, Koninklijke Philips NV Medical Advisor, MIM Software Inc , Raj Mohan Paspulati MD (Presenter): Research grant from Philips Healthcare

TEACHING POINTS

-To gain knowledge about current PET/MRI technology in the clinical practice -To learn about the potential strengths and weaknesses of FDG PET/MRI and PET/CT as well as potential added value of PET/MRI over PET/CT -To learn about the challenges and solutions for PET/MRI clinical workflow in the evaluation of colorectal cancer.

TABLE OF CONTENTS/OUTLINE

In this Education Exhibit, we provide an update on the three hybrid PET/MRI systems currently available in the market. We then illustrate the strengths and weaknesses of FDG PET/MRI and PET/CT in case studies, as well as demonstrate the added value of PET/MRI in colorectal cancer staging and restaging, based on a sequential PET/MRI system (Ingenuity TF PET/MRI, Philips Healthcare). The workflow of PET/MRI for the evaluation of colorectal cancer is challenging not at least because of the co-administration of glucagon during the MRI examination, which may affect the FDG PET image quality. We discuss the unique attributes of clinical workflow to optimize the PET/MRI examination in terms of image quality, time efficiency and patient comfort. Summary: This Education Exhibit provides helpful information about current clinical PET/MRI systems and illustrate the strengths and weaknesses of PET/MRI compared with PET/CT, as well as discuss about challenges and solutions for clinical workflow.
The time-spatial labeling inversion pulse (Time-SLIP) technique is a new MRI technique based on arterial spin labeling. It can visualize not only the blood flow but also intravital flows such as the cerebrospinal fluid flow and pancreatic secretion. The purpose of this study was to assess the feasibility of the Time-SLIP technique for demonstrating salivary flow in normal volunteers.

METHOD AND MATERIALS

Using a 3T-MRI scanner (Vantage Titan 3T; Toshiba), surface coils placed on the parotid gland, and the "flow-in" method of the Time-SLIP technique, we acquired images of salivary flow from the right parotid gland of 16 normal volunteers ranging in age from 24-53 years (median 40.5 years). We applied a spatially selective inversion recovery (IR) pulse to a parotid duct and then determined the black blood inversion time (time from the selective IR pulse to image acquisition) to null the background signal. We scanned the parotid duct 24 times at identical intervals. To stimulate saliva secretion we injected 1 mL of 2% citric acid into the mouth before scans 5, 9, 13, 17, and 21, and scored visualization of the parotid duct on the flow images (grade A= 100% visualization, grade B= 50-99% visualization, grade C= 1-49% visualization, grade D= incomplete visualization). We also measured the mean signal intensity ratio (SIR) of the parotid gland ([mean SI during each Stimulation] / [mean unstimulated SI=1]) during each Stimulation (Stimulation1=1st scan, Stimulation2=2nd scan, Stimulation3=3rd scan, Stimulation4=4th scan after stimulation).

RESULTS

With the Time-SLIP technique salivary flow from the parotid gland could be visualized in 15 of 16 volunteers. The scores were A in 1-, B in 8-, and C in 6 volunteers. Mean SIR during each Stimulation1, 2, 3, 4 were 1.18 (standard deviation 0.28), 1.21 (0.23), 1.14 (0.17), and 1.11 (0.16), respectively. In 9 of 15 volunteers salivary flow could be most clearly visualized on the 2nd scan after each stimulation.

CONCLUSION

Salivary flow from the parotid gland could be visualized in 15 of 16 volunteers on images acquired with the Time-SLIP technique.

CLINICAL RELEVANCE/APPLICATION

The Time-SLIP MRI technique holds promise for the quantitative and qualitative evaluation of salivary flow. It may be useful in the evaluation of patients with reduced salivary secretion, e.g. patients with Sjogren syndrome and patients undergoing radiation therapy for head and neck tumors.

Post-traumatic Cervical Spine Extra-Arachnoid Collections: Characteristics that May Allow for Conservative Management (Station #2)

David Lawrence MD : Nothing to Disclose, Michael Gregory Fox MD (Presenter): Stockholder, Pfizer Inc, Brian Michael Trotta MD : Nothing to Disclose, Michelle S. Barr MD : Nothing to Disclose, Prashant Raghavan MD : Nothing to Disclose, Francis H. Shen MD : Consultant, Johnson & Johnson Consultant, Globus Medical, Inc Royalties, Globus Medical, Inc Royalties, Reed Elsevier

PURPOSE

Determine characteristics of post-traumatic cervical spinal extra-arachnoid collections that may allow for conservative management instead of surgical decompression.

METHOD AND MATERIALS

IRB approval obtained. Over a 17 month period, we retrospectively reviewed cervical spine MRIs on all patients >16-years-old with post-traumatic extra-arachnoid fluid collections. Patients were divided into 4 groups: 1) fusion for unstable spinal injuries (n=21); 2) small collections that required no treatment or follow-up (n=18); 3) surgical evacuation for neurologic deficits (n=1); and 4) moderate to large collections with follow-up MRI within 30 days (n=9). Group 4 collections were then evaluated for size, morphology and MR signal intensity.

RESULTS

No group 4 collection enlarged and no patient (mean age-40 years) developed worsening neurologic symptoms. 78% (7/9) of the collections demonstrated thin, tapered margins, extended >9.5 cm in length and had variable signal characteristics: hyper-T1/iso-T2 (n=1), iso-T1/T2 (n=3), hyper-T1/hypo-T2 (n=3), and mixed-T1/T2 (n=1). Follow-up MRI demonstrated complete resolution or significant decrease (n=4) between 1 to 12 days; stable or slight decrease (n=3) between 2 to 11 days. Two neurologically intact patients refused surgery for 2 mass-like collections that were then managed conservatively. These collections measured 2-3 levels in length, were confined to <90 degrees of the spinal canal diameter. One collection was slightly smaller after 1 day and 1 resolved after 31 days.

CONCLUSION

Post traumatic extraarachnoid spinal collections that have ventral and dorsal components with long, thin tapered margins will often resolve rapidly, irrespective of the signal characteristics.

CLINICAL RELEVANCE/APPLICATION

Conservative management of post-traumatic extra-arachnoid collections that have long thin tapered margins with serial neurologic checks and follow-up MRIs is safe in neurologically asymptomatic or stable patients.
Improved Reliability of Diffusion Tensor Imaging Utilizing Reduced Field-of-View ZOOM-EPI in Normal Human Cervical Spinal Cord (Station #3)

Michael M. Poplawski MD, PhD (Presenter): Nothing to Disclose, Richard Joseph Thomas Gorniak MD: Speaker, Koninklijke Philips NV, M. Alex Dresner PhD: Employee, Koninklijke Philips NV, Adam Eugene Flanders MD: Nothing to Disclose

PURPOSE

ZOOM-EPI technique has been shown to provide subjectively superior MR diffusion image quality compared to full-field ssEPI (fEPI) in the cervical cord. However, it has not been shown if the diffusion tensor imaging (DTI) metrics are comparable for the two techniques. The study aim was to determine consistency of DTI values in normal human cervical spinal cord using ZOOM DTI.

METHOD AND MATERIALS

Regions-of-interest were drawn at seven levels on axial DTI images from C1/2 to C7/T1 in 9 normal cervical cords acquired with fEPI and ZOOM on a Philips Achieva 1.5 T, with parameters (TR/TE/NSA/FOV/Matrix/slice#/slice(mm)/in plane(mm)): fEPI 6176/82/8/220x130mm/144x84/36/4mm/1.53x1.53mm, ZOOM 4950/95/4/110mm/96x96/32/4mm/1.15x1.15mm. Both sequences used 6 directions at b=800, and acquisition time of under 5 minutes. Mean fractional anisotropy (FA), apparent diffusion coefficient (ADC), and signal-to-noise (SNR) values were compared. These metrics were also compared in age-matched normal cords that were imaged with one DTI technique (fEPI, n=22), or the other (ZOOM, n=23) using two-way ANOVA, followed by Sidak's test.

RESULTS

Measured cord ROI volumes were equivalent at all levels, despite disparate voxel size. In a paired comparison within same cords, FA was higher (p

CONCLUSION

Within similar acquisition times, ZOOM provides more consistent estimates of FA and ADC in the cervical cord. This is attributed to a gain in resolution, less volume averaging from CSF, and diminished artifact. With superior image quality and more reliable DTI metrics, ZOOM is recommended over conventional ssEPI DTI for clinical applications in cervical spinal cord imaging.

CLINICAL RELEVANCE/APPLICATION

Introduction of spinal cord DTI into clinical practice will depend on availability of a reliable and practical DTI sequence. In that respect, ZOOM-EPI DTI provides a clear advantage over ssEPI DTI.

Right Arcuate Fasciculus Disruption in Chronic Fatigue Syndrome (Station #4)


PURPOSE

(1) Detect microstructural abnormalities underlying chronic fatigue syndrome (CFS) using diffusion tensor imaging (DTI), (2) assess if gray and/or white matter volumes are abnormal utilizing T1-weighted volumetric analysis, and (3) detect suspected global alterations in brain perfusion using pseudo-continuous arterial spin labeling (ASL).

METHOD AND MATERIALS

15 CFS patients and 14 controls provided informed consent in accordance with Stanford's Institutional Review Board and HIPAA. Subjects underwent 3.0T volumetric T1 and T2-weighted imaging, two DTI acquisitions, and ASL. Segmentations of supratentorial gray and white matter and cerebrospinal fluid were used to compare gray and white matter volume fractions and cortical thickness. DTI was processed with automated fiber quantification (AFQ), which compares piecewise fractional anisotropy (FA) along 20 tracks. The FreeSurfer segmentation was used to compare cerebral blood flow.

RESULTS

Bilateral white matter volume and right thalamic volumes were reduced in the CFS population. In CFS, FA was increased in the right arcuate fasciculus, and cortical thickness increased in both of its endpoints: the right middle temporal and right precentral gyri. In right-handers, FA was also increased in the right inferior longitudinal fasciculus, and thickness increased in one endpoint, the right occipital lobe. Within CFS patients, right anterior arcuate FA as well as basal ganglia volumes increased with disease severity. ASL showed no significant differences.

CONCLUSION

Bilateral white matter and right thalamic atrophy are present in CFS. Right hemispheric increased FA and cortical thickness are present, suggestive of a compensatory or pathological network. Right anterior arcuate FA may serve as a biomarker for CFS.

CLINICAL RELEVANCE/APPLICATION

Automated tractography can be useful for studying the microstructure underlying neurological disorders.
A Diffusion Tensor Imaging Comparative Study of the Cervical Spinal Cord in Neuromyelitis Optica and Multiple Sclerosis (Station #5)

Jing Huang (Presenter): Nothing to Disclose, Yaou Liu MD, PhD: Nothing to Disclose, Yunyun Duan: Nothing to Disclose, Zhuoqiong Ren: Nothing to Disclose, Kuncheng Li MD: Nothing to Disclose

PURPOSE

To assess the diffusion changes in normal-appearing spinal cord (NASC) in patients with neuromyelitis optica (NMO) and multiple sclerosis (MS).

METHOD AND MATERIALS

Axial DTI of the cervical spinal cord was performed in 14 patients with NMO, 14 patients with MS and 14 sex- and age-matched normal controls. Fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD) and radial diffusivity (RD) were measured in regions of interest (ROIs) at the C2-C5 levels in four columns of the spinal cord. Student's t-test were used for the comparison of DTI parameters.

RESULTS

Compared with normal controls, the values of MD were increased and FA were decreased for both MS and NMO groups, there were significant differences among them. Compared with MS groups, FA in patients with NMO was significantly decreased in the lateral, posterior columns, AD and MD in the lateral and posterior columns was significantly increased.

CONCLUSION

There are extensive NASC damage in both NMO and MS patients, including white matter areas of the cervical spinal cord, mainly caused by demyelination. This suggests the different spinal cord lesion pattern in NMO and MS.

CLINICAL RELEVANCE/APPLICATION

This study suggests the different spinal cord lesion pattern in NMO and MS, it helps the early diagnosis and differential diagnosis between NMO and MS.

Changes in Brain Connectivity and Its Correlation with Idiopathic Complex Partial Seizures Epilepsy Patients: Evidence from Resting-State fMRI (Station #6)

Qiao Peng fei MD (Presenter): Nothing to Disclose, Yang Gao: Nothing to Disclose, Guang ming Niu: Nothing to Disclose

PURPOSE

To investigate the modifications of resting state fMRI (rfMRI) in complex partial seizures (CPS) epilepsy patients employing regional homogeneity (ReHo), the amplitude of low frequency fluctuation (ALFF) and the functional connectivity (FC) techniques.

METHOD AND MATERIALS

Thirty-seven right-handed CPS patients were recruited and investigated in the comparison with 37 matched in age, gender and education background controls. All subjects underwent MR scanning on a 3.0 Tesla scanner (GE-Signa HDx, Milwaukee, US.). Functional MRI scanning was performed using GRE-EPI sequences (FOV 24 cm×24 cm, 64×64 matrix, flip angle 90°, TR 2000 ms, TE 30 ms, whole brain coverage, 38 oblique axial, 4mm slices thickness and 0mm inter-slice space). Resting-state scanning lasted for 512s, producing 256 brain volume data sets. The first 10 images were excluded due to T1 equilibrium effects. T1-weighted 3DBRAVO-sequence images (FOV 24 cm×24 cm, 256×256 matrix, whole brain coverage, flip angle 13°, TR 7.8 ms, TE 3.0 ms) were achieved to assess the anatomical images for the co-registration of fMRI data with standard space coordinates. ReHo, ALFF and FC were processed using REST and SPM8 software to compare the resting state function in the whole brain between two groups.

RESULTS

Medial temporal lobe and surrounded brain regions were observed to participate the interictal epileptiform discharges (IEDs), and the default mode network (DMN). The cerebellum of CPS patients was the most commonly damaged region resulted from the abnormal neural electrical activities.

CONCLUSION

ReHo, ALFF and FC can detect interictal epileptiform abnormality, and can be possibly applied as an additional non-invasive tool for the detection of epileptogenic foci. Furthermore, the alterations in amplitude play a central role in epileptogenesis.

CLINICAL RELEVANCE/APPLICATION

ReHo, ALFF and FC can detect abnormal BOLD signals, localize the epileptic zones, and may be applied to evaluate the pathophysiological mechanisms of epilepsy.
Long Term Height Maintenance of the Percutaneous Augmented Vertebral Body for the Treatment of Symptomatic Osteoporotic Compression Fractures (Station #7)

Ahmed Fadl MD (Presenter): Nothing to Disclose, Carla Alexis de Venecia MD: Nothing to Disclose, A. Orlando Ortiz MD, MBA: Nothing to Disclose

PURPOSE
To determine if percutaneous vertebral augmentation (PCA) provides long-term stability without significant changes in height over time in patients treated for osteoporotic compression fractures.

METHOD AND MATERIALS
A single institution PACS database query was conducted to determine the number of patients who underwent either vertebroplasty or kyphoplasty for back pain secondary to vertebral osteoporosis induced compression fracture. Augmented vertebral height measurements were analyzed from images during pre-intervention, immediate post-intervention, and at varying points during follow up examinations. Vertebral height measurements were measured and standardized against an internal control depending on the imaging modality. Controls were designated using a stable vertebral body and/or using an imaging device of a known constant dimension. The ratio of heights between two values (injected vertebral body versus internal control) were recorded over time and compared to other ratio values at various time intervals.

RESULTS
45 patients met inclusion criteria (42 women / 3 men) with the distribution of kyphoplasty to vertebroplasty being 48 and 77 respectively. Of the 45 patients, 110 vertebral bodies were augmented. 41 of the 45 were on supplemental pharmacologic management for osteoporosis. Average imaging follow up was 4.7 years. All augmented vertebral bodies demonstrated adequate endplate-to-endplate filling. Follow-up imaging of the 110 injected vertebral bodies demonstrated no statistically significant change in vertebral height over time with a p-value of 0.46.

CONCLUSION
The findings of the study demonstrate that vertebral augmentation yields stable vertebral bodies with no change in overall vertebral body height over time. There was no statistically significant difference between the two techniques or pharmacologic treatment. Limitations of the project included comparison of relative vertebral heights versus absolute values. Further analysis utilizing a prospective cohort with absolute internal controls is needed to further add validity to the current findings.

CLINICAL RELEVANCE/APPLICATION
The findings of the study provide clinical evidence to support that percutaneous vertebral augmentation provides long term stability with respects to height for those patients with osteoporotic induced vertebral compression fractures.

Spinal Canal Masses: Case Based Review of Various Mass Lesions and the Differential Diagnostic Considerations according to Compartmental Location (Station #8)

Nishith Patel MD (Presenter): Nothing to Disclose, Jay Patel MD: Nothing to Disclose, Amir Salomon MD: Nothing to Disclose

TEACHING POINTS
1. Review the anatomy of the spinal canal anatomy and its various compartments. 2. Review different imaging techniques available to evaluate spinal canal lesions. 3. Learn imaging features of a variety spinal canal masses based on compartmental location: intramedullary, extramedullary intradural, and extradural.

TABLE OF CONTENTS/OUTLINE
1. Approaches to image the spinal canal
2. Overview of the spinal canal anatomy and its contents and various spaces.
3. Extradural lesions
4. Intradural, Extramedullary lesions
5. Intramedullary lesions

After completing this educational exhibit, the reviewer will be familiar with the spinal canal anatomy and commonly used imaging techniques. The reviewer will also be confident about the different spaces within the spinal canal and use it to aid their formulation of a differential diagnosis.

MR Imaging Characteristics of Typical and Atypical Intraorbital Neoplasms (Station #9)

Jeffrey Dorr MD (Presenter): Nothing to Disclose, Priya Krishnarao MD: Nothing to Disclose, Rajul Parimal Pandit MD: Nothing to Disclose, Mahesh Ramu Patel MD: Stockholder, Novartis AG

TEACHING POINTS
The purpose of this exhibit is:
1. To review pertinent anatomy and anatomic relationships of the orbit
TABLE OF CONTENTS/OUTLINE

Basic Anatomy - Contents of the orbit - Osseous boundaries of orbit - Intracanal, Conal, and Extraconal spaces - Foramina relating spread of pathology (including superior orbital fissure, inferior orbital fissure) Sample cases with explanation of pertinent MR imaging characteristics: - Orbital MALT lymphoma - Meningioma - Metastatic disease - Orbital Pseudotumor - Orbital dermoid Conclusion - Key features of neoplasms involving the orbit and their differentiating MR imaging characteristics

NRE219

Abnormalities of the Basal Ganglia and Thalamus; MRI Findings in Common and Uncommon Entities (Station #10)

Jehan Al-Rayahi MD (Presenter): Nothing to Disclose, Walid Mabrouk Mubarak: Nothing to Disclose, Khaled Salem Doghem: Nothing to Disclose

TEACHING POINTS

To understand the anatomy & distinctive features of deep grey matter. The basal ganglia & thalami (BG &T) constitute paired structures of the deep grey matter nuclei that are unique in their high metabolic activity, rich blood supply and mitochondrial content. This makes them susceptible to a wide spectrum of metabolic, toxic and vascular pathology. To present an overview of the different etiologies of BG&T abnormalities. These include: 1) Toxic, 2) Metabolic, 3) Vascular, 4) Infectious/Inflammation & 5) Hereditary/Degenerative. To learn the approach in the assessment of abnormalities of the BG&T which include the 3 steps: 1) Is it an isolated abnormality of the basal ganglia? If not, what other regions are involved? 2) What is the primary nuclei affected? & 3) What MRI signal changes is noted? To understand that findings should always be interpreted with attention to patient age, clinical setting (including acuity/chronicity of the presentation) & correlation with laboratory findings

TABLE OF CONTENTS/OUTLINE


NRE336

Brachial Plexus Imaging: Everything That a Radiologist Needs to Know for Reporting! (Station #11)

Drushi Vatsal Patel MBBS, MD (Presenter): Nothing to Disclose, Hemant Tribhovandas Patel MD: Nothing to Disclose, Ankur Shah MD: Nothing to Disclose, Shikha Rahul Khandelwal MBBS, DMRD: Nothing to Disclose, Laxmi Vishnu Bhobe DMRD: Nothing to Disclose, Mrugesh Doctor: Nothing to Disclose

TEACHING POINTS


TABLE OF CONTENTS/OUTLINE


NRE270

Practical Approach to Sensorineural Hearing Loss in Pediatric Patients (Station #12)

Jeffrey Sachs MD: Nothing to Disclose, Colin Michael Segovis MD, PhD (Presenter): Nothing to Disclose, Michael E. Zapadka DO: Nothing to Disclose

TEACHING POINTS

Sensorineural hearing loss (SNHL) is a major cause of childhood disability with significant implications on language development, school performance and social integration. Cross-sectional imaging plays an integral role in evaluating children with SNHL and otolaryngologists routinely request CT or MRI exams to assess anatomy of the temporal bone and evaluate potential causes for hearing loss. Because early diagnosis and intervention can improve language development in children, these studies are now ordered with increased frequency, even in the community setting. Knowledge of the anatomy and spectrum of congenital and acquired pathologies associated with SNHL in children is requisite for the radiologist to add value in clinical practice. Radiologists will increase their confidence in approaching the pediatric temporal bone and recognizing common pathologies by utilizing a practical, step-wise guide.

TABLE OF CONTENTS/OUTLINE

- Anatomy of the temporal bone. - Differential considerations for SNHL in the pediatric population. - Image-rich examples of the most common causes of SNHL in children with emphasis on high-resolution CT of the temporal bone and MRI. Appropriate emphasis on unique anatomic, embryologic, and pathophysiologic concepts will be discussed. - A practical, step-wise approach to the evaluation of inner ear anomalies in pediatric patients.
Central Nervous System Vasculitis, From Small to Large Blood Vessels (Station #13)

Griselda Teresa Romero Sanchez MD (Presenter): Nothing to Disclose, Jesus Antonio Higuera-Calleja: Nothing to Disclose, Mariana Diaz-Zamudio MD: Nothing to Disclose, Johnatan Rubalcava Ortega MD: Nothing to Disclose, Maria Alejandra Gonzalez Duarte B MD: Nothing to Disclose, Sergio Rangel MD: Nothing to Disclose, Daniel Montante Montes De Oca MD: Nothing to Disclose, Monserrat Reig Sosa MD: Nothing to Disclose, Jorge Vazquez-Lamadrid MD: Nothing to Disclose

TEACHING POINTS
To review the pathophysiology of central nervous system (CNS) vasculitis. To describe common and uncommon imaging findings in Computed Tomography, Magnetic Resonance and invasive angiography in CNS vasculitis.

TABLE OF CONTENTS/OUTLINE
Relevant teaching points are illustrated through a case series (15 complete cases) from our Institution, obtained from a retrospective search from 2005 to 2014: 1. Etiology, pathology, clinical course and management of CNS vasculitis. 2. Common and uncommon findings with a multimodality approach a. Computed Tomography b. Magnetic Resonance c. Invasive angiography 3. Main differential diagnoses and pitfalls, a pathway to correct diagnosis.

Beyond Flaps and Crescents: Pearls and Pitfalls in Diagnosing Craniocervical Dissection (hardcopy backboard)

Marcin Konrad Kolber MD: Nothing to Disclose, Mika Lidov MD: Nothing to Disclose, Jeremy Whang MD (Presenter): Nothing to Disclose

TEACHING POINTS
Classic signs of dissection of the carotid or vertebral arteries include crescent-shaped intramural hematoma, intimal flap, and narrowed lumen. However, these findings are not always reliable, and when present, may be difficult to identify or mimicked by artifact. We hope to expand the reader’s toolkit for identifying dissections by providing a pictorial review of: Common pitfalls with MRI, MRA, and CTA resulting in a missed diagnosis Imaging pearls to improve sensitivity Artifacts impacting diagnosis

TABLE OF CONTENTS/OUTLINE
Pitfalls:

- Clot shine-through on MRA simulating normal flow-related enhancement
- Normal-sized lumen despite presence of intramural hematoma
- Occult hematoma on 2DTOF visible as halo sign on 3DTOF
- Clot not hyperintense on T1 or T2FS
- Distal occlusion with proximal slow flow, simulating the appearance of proximal dissection
- Peri-vertebral plexus simulating V2 dissection

Pearls:

- Halo sign: T1 hyperintense thrombus surrounding the arterial lumen
- Susceptibility artifact on MRA source image, helping distinguish true lumen from clot
- Proper CT windowing to identify intimal flap and thrombus

Artifacts:

- Signal loss in ICA bulb caused by turbulent flow
- Entry flow phenomenon
- Skull base flow gap

New Classification of Mullerian Anomalies, Clinical Implications, and Treatment Frontiers (Station #1)

Mariam Moshiri MD (Presenter): Consultant, Reed Elsevier Author, Reed Elsevier, Suresh Maximin MD: Nothing to Disclose, Sherif Osman MD: Nothing to Disclose, Christine O. Menias MD: Nothing to Disclose, Puneet Bhargava MD: Editor, Reed Elsevier, Sabrina Mahboob MBBS: Nothing to Disclose, Douglas S. Katz MD: Nothing to Disclose

TEACHING POINTS
The most commonly used classification system for mullerian anomalies is that created by American Fertility Society (AFS). Occasionally anomalies are identified on imaging which do not closely match any of the described classes. Very recently the EUROPEAN SOCIETY OF HUMAN REPRODUCTION AND EMBRYOLOGY and EUROPEAN...
SOCIETY FOR GYNECOLOGICAL ENDOSCOPY formed a working group CONUTA to arrive at a more accurate and objective classification. The working group has developed a new system based on scientific research and recommendations of experts. The purpose of the exhibit is therefore to review the new classification system, explain how this system builds on and clarifies the AFS system, and to demonstrate how to use the system with imaging case examples.

**TABLE OF CONTENTS/OUTLINE**

Review the newly proposed classification of mullerian anomalies, which includes: U (uterus), C (cervix), V (vagina) categorization for each given anomaly, compare the new system with the currently used AFS classification system. Review representative cases with multiple imaging modalities: US, 3D US, MR, hysterosalpingography and in selected cases CT. Review clinical implication for fertility and patient management. Review clinical treatment methods based on new classification system. Review new treatment frontiers for treatment of female infertility, including uterus transplantation.

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**OBE100**

"Fetal Malformations of the External Ears: More Than What It Sounds" (Station #2)

Maria A. Calvo-Garcia MD (Presenter): Nothing to Disclose, Rupa Radhakrishnan MD: Nothing to Disclose, Arnold Carlson Merrow MD: Author, Amirsys, Inc Editor, Amirsys, Inc Employee, Amirsys, Inc, Beth M. Kline-Fath MD: Nothing to Disclose

**TEACHING POINTS**

The ear (also known as pinna or auricle) is not frequently targeted during the routine fetal anatomic assessment. However, it could provide important clues in the presence of other facial or systemic anomalies. We will review basic embryologic steps in the formation of the face that will help understand the pattern of specific ear malformations. Subsequently, we will present the imaging evaluation of a group of clinical conditions with their postnatal correlations. With this exhibit, we expect the reviewers to become familiar with characteristic scenarios and potential search patterns during US and fetal MRI evaluations.

**TABLE OF CONTENTS/OUTLINE**


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**PDS-TUA**

**Pediatric Tuesday Poster Discussions**

**Scientific Posters**

*AMA PRA Category 1 Credits™: .50*

*Tue, Dec 2 12:15 PM - 12:45 PM  Location: S101B*

**Participants**

Moderator
Joao Guilherme Amaral MD: Nothing to Disclose

**Sub-Events**

**PDS232**

Dose-optimized Bolus Tracking in Pediatric Cardiac CT Angiography (Station #1)

Lena Gordon Murkes MD (Presenter): Nothing to Disclose, Marika Gullberg Lidegran MD, PhD: Nothing to Disclose

**PURPOSE**

Bolus tracking (BT) in pediatric CTA is associated with non-negligible contributions to the patient's radiation dose. To mitigate radiation dose, a fixed scan delay for the timing of iodinated contrast medium (ICM) has been recommended by other institutions, in place of BT. The aim of this study was to minimize the radiation dose contribution from BT while preserving optimal ICM timing, for pediatric cardiac CTA.

**METHOD AND MATERIALS**

The BT was optimized (from scanner default) by setting the tube parameters to 80 kV/10 mAs, postponing the start of BT to 10 seconds after the start of the bolus injection, and decreasing the BT monitoring frequency to 1/s. The DLP was used to compare the radiation dose from BT prior to and after optimization. The study included 118 children (2 days-3 years old) examined with a cardiac CTA protocol, over a 3-year period. The ICM (2 ml/kg, 320 mgI/ml) bolus was administered with a dual power injector followed by the double amount of saline chaser. Depending on the vessels of interest, the ICM injection time varied between 12-15 seconds. The diagnostic scans were triggered manually using BT as a reference for the arrival of ICM. The feasibility of using fixed scan delays for ICM timing was investigated by studying the time between the start of the bolus injection and the start of the diagnostic scan.

**RESULTS**
All 118 examinations provided CTA images of diagnostic value and the majority of the scans had excellent ICM timing. Prior to optimization, the DLP for BT varied from 1-15 (mean 7.9) mGycm. After optimization, the DLP for BT decreased to 1-2 (mean 1.4) mGycm. As a comparison, the mean DLP for the diagnostic scans was 16 mGycm. The time from bolus injection start to diagnostic scan varied between 18 and 32 seconds, making a fixed scan delay for ICM timing elusive.

CONCLUSION

BT is an important tool to achieve a well-timed CTA examination, with respect to ICM. Excellent ICM timing can be preserved with an optimized BT, which only contributes a fraction of the radiation dose compared to non-optimized BT. Furthermore, optimal ICM timing is paramount to allow for further dose optimization in pediatric CTA.

CLINICAL RELEVANCE/APPLICATION

The use of bolus tracking is recommended to achieve a well-timed CTA examination and with optimized settings the dose contribution will be negligible.

PDS233

CE MRA in Pediatric Patients with Vascular Malformations and/or Congenital Heart Disease: Combination of Time Resolved and Multiphase High Resolution MRA in One Examination at a Total Contrast Medium Dose of 0.1 mmol/kg BW Gd-BOPTA (MultiHance) (Station #2)

Guenther Karl Schneider MD, PhD (Presenter): Research Grant, Siemens AG Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG Research Grant, Bracco Group Speakers Bureau, Guerbet SA, Jonas Stroeder MD: Nothing to Disclose, Arno Buecker MD: Consultant, Covidien AG Speaker, Covidien AG Co-founder, Aachen Resonance GmbH Research Grant, Siemens AG, Alexander Massmann MD: Nothing to Disclose

PURPOSE

To evaluate the combination of time resolved and high resolution dynamic contrast enhanced MRA of vascular malformations in the pediatric age group during one examination with a total dose of 0.1 mmol/kg Gd-BOPTA (MultiHance) divided for the two examinations.

METHOD AND MATERIALS

MRA was performed in a total of 28 pts. (2-15 yrs) with congenital vascular malformations / CHD, either for diagnosis or in follow-up post surgery. MRI was performed on a 1.5 T Siemens scanner (Aera). The total contrast medium dose was divided in a dose of 0.025 mmol/kg for a high temporal resolution TWIST sequence (time per dataset < 3 sec) and 0.075 mmol/kg for a high spatial-resolution 3D GRE-Sequence MRA (8-14 sec), which was acquired 2-3 times post contrast medium injection. To allow for an extended breath-hold younger children underwent imaging during intubation and controlled ventilation. Images were evaluated by two readers regarding detection of vascular malformations, post surgical anatomy and shunt dynamics and morphology.

RESULTS

A dose of 0.025 mmol/kg Gd-BOPTA allows for depiction of vascular anatomy and flow using a time-resolved angiography with interleaved stochastic trajectories (TWIST). Additional functional information, regarding flow directions in shunts, post surgical evaluation of anomalous venous return incl. scimitar malformation and other malformations in CHD could be demonstrated by both readers in 17 of 28 patients in time resolved MRA. However high-spatial resolution images at a dose of 0.075 mmol/kg allowed for detection and exact quantification of vascular stenosis respectively vessel diameters and small abnormal vessels, which were not demonstrated on time-resolved imaging, for example small sequestration arteries. Both readers rated the degree of enhancement as good or excellent as well in time resolved and high resolution imaging.

CONCLUSION

Time resolved and high resolution MRA can be performed by dividing a total dose of only 0.1 mmol/kg BW Gd-BOPTA for both examinations. The higher relaxivity of Gd-BOPTA allows for this small amount of contrast medium. The two techniques should be regarded as complementary since both techniques gave additional clinical relevant information.

CLINICAL RELEVANCE/APPLICATION

Since the advent of NSF Gd-dose in CE MRA should be kept as small as possible, time resolved and high resolution imaging can be performed in one examination with a total dose of only 0.1 mmol/kg BW.

PDS234

Pediatric Interventional Radiology Radiation Dose Reduction with a Novel C-Arm Imaging Technology: A Population Study Based on 355 Patients (Station #3)

Keith J. Strauss MS (Presenter): Research Consultant, Koninklijke Philips NV Speakers Bureau, Koninklijke Philips NV, John Miras Racadio MD: Research Consultant, Koninklijke Philips NV Travel support, Koninklijke Philips NV, Rami Nachabe PhD: Consultant, Koninklijke Philips NV

PURPOSE

To compare pediatric procedural doses when using a reference technology (Allura Xper, Philips Healthcare) and a novel advanced image processing and dose reduction technology (AlluraClarity, Philips Healthcare) interventional radiology systems.

METHOD AND MATERIALS

Pediatric interventional radiology and angiography was performed from 48 pediatric clinics around the US.
Radiation dose structured reports were retrospectively collected from 408 clinical pediatric cases; half performed with the reference and half with the novel X-ray technology. Dose-area product and fluoroscopy time were collected to compare procedural radiation dose. Procedural dose is defined as the total dose excluding any volumetric acquisitions (i.e. 3D rotational or cone beam CT).

RESULTS

180 and 175 patients underwent procedures with the reference and the novel technology, respectively. The 21 different procedure types covered a wide spectrum of pediatric interventional procedures yielding a total number of 204 procedures with each technology. The observed median ages of 12.6 and 11.6 years for the reference and the novel technology, respectively were not statistically different. No statistical difference in age distribution for both groups was observed. Weight and body mass index for both groups were not statistically different in median and distribution with medians being 36 vs 39 kg and 18.3 vs 18.2 kg/m2 for reference vs novel technology. Fluoroscopy time per procedure (median of 1.6 and 1.5 min for reference and novel technology respectively) and total recorded images (median of 2 frames per procedure) had statistically similar median, variance, and distribution for both groups. Procedural dose was significantly decreased from reference to novel X-ray imaging technology yielding a radiation dose 35% of its original value (1090 vs 385 mGy.cm², p<0.0001). The fluoroscopy and fluorography acquisitions with the novel X-ray technology delivered 37% and 30% of the dose, respectively, of the reference technology.

CONCLUSION

With the novel advanced image processing and dose reduction technology, radiation dose of pediatric interventional procedures was reduced to 35% of its original value.

CLINICAL RELEVANCE/APPLICATION

Pediatric Interventional Radiology procedural dose is significantly decreased with AlluraClarity, a novel advanced image processing and dose reduction technology.

PDS235

Transient Flow Response after Femoral Artery Catheterization for Diagnostic Neuroangiography in Infants and Children: Doppler Ultrasound Assessment of the Ipsilateral Femoral Artery (Station #4)

Seongho Kim (Presenter): Nothing to Disclose, Younghun Choi MD : Nothing to Disclose, Jung-Eun Cheon MD : Nothing to Disclose, Woo Sun Kim MD : Nothing to Disclose, Su Yeon Ahn : Nothing to Disclose, Seonji Jeong : Nothing to Disclose, In-One Kim : Nothing to Disclose

PURPOSE

To evaluate arterial flow changes of the lower extremities ipsilateral to the puncture site using Doppler ultrasonography (US) during transfemoral cerebral angiography (TFCA) in children.

METHOD AND MATERIALS

From April 2013 to August 2013, a total of 27 pediatric patients underwent TFCA in our institution comprising our study population. Doppler US was performed to evaluate diameters and peak systolic velocities (PSVs) of the common femoral artery (CFA) and superficial femoral artery (SFA) before and after femoral sheath insertion. Patients were subclassified into three groups based on the spectral waveform changes of the SFA after femoral sheath insertion. Thereafter, one-way ANOVA followed by Bonferroni’s post-hoc comparisons test was performed to compare values among the groups.

RESULTS

Mean CFA and SFA baseline diameters were 4.10 mm and 3.32 mm, and mean CFA and SFA baseline PSVs were 218.26 cm/sec and 166.51 cm/sec, respectively. Fourteen of 27 patients showed persistent triphasic flow in the SFA (group 1), 7 patients showed altered flow of biphasic (n=3) or monophasic (n=4) waveforms (group 2), and 6 patients showed “pulsus tardus et parvus” (group 3) after femoral sheath insertion. Mean baseline CFA diameter and mean subtracted value between CFA and femoral sheath size were significantly smaller in group 3 (P <.0001). Size discrepancy between CFA and femoral sheath was < 1mm in all cases of group 3. SFA diameter and PSV significantly decreased after femoral sheath insertion in group 3 compared to groups 1 and 2. A significant skin temperature drop after sheath insertion in the ipsilateral lower extremity was noted in group 3 (-1.83°C), compared to groups 1 and 2 (+0.42°C and -0.86°C, respectively).

CONCLUSION

Changes in the spectral waveforms of SFAs frequently occur in pediatric patients during TFCA (13/27, 48%). Significant arterial flow disturbance was noted on Doppler US in children with CFA < 1mm larger than the femoral sheath diameter.

CLINICAL RELEVANCE/APPLICATION

We suggest sonographic evaluation of the size difference between the CFA and the femoral sheath prior to transfemoral catheterization in pediatric patients.

PDS236

Clinical Findings from Semi-Automated Adipose Volume Measurements from Routine Body CT (Station #5)

Chunzhe Duan MS, BS : Nothing to Disclose, Nabile M. Safdar MD : Shareholder, Montage Healthcare Solutions, Inc, Evan P Nadler MD : Nothing to Disclose, Jiamin Liu PhD : Nothing to Disclose, Ronald M. Summers MD, PhD : Royalties, iCAD, Inc Research funded, iCAD, Inc Stockholder, Johnson & Johnson Grant, Viatronix, Inc, Marius George Linguraru DPhil, MS (Presenter): Nothing to Disclose
PURPOSE

To investigate the associations between adipose volumes, body mass index (BMI), and clinical parameters (i.e., insulin resistance (IR), hyperglycemia (HG), hypertension (HTN), blood pressure (BP) and blood glucose (BG)) in pediatric patients.

METHOD AND MATERIALS

This retrospective study was IRB approved. We collected axial contrast-enhanced CT images of 235 patients (96 boys and 139 girls) aged 13 to 20 years. The patients' ethnic breakdown was: 47 Caucasian, 131 African-American, 40 Hispanic/Latino and 17 other race/ethnicity. There were 35 morbidly obese (BMI>40.0) and equal bins of 50 cases of under-weight (BMI<18.5), normal (18.5≤BMI<25.0), over-weight (25.0≤BMI<30.0) and obese (30.0≤BMI<40.0) cases. Adipose tissue volume measurements were performed using previously validated automatic software followed by manual corrections when necessary. We assessed the volume of visceral fat (VAT), subcutaneous fat (SAT), total fat (TAT) and body volume in the region of vertebrae L2 to L4. Percentage of fat in this region (%VAT, %SAT, %TAT) and maximum relative fat volume (MRVAT, MRSAT, MRTAT) in each axial slice were calculated. Spearman’s rank correlation and generalized linear models (GLM) adjusted for age, sex and race/ethnicity were used for data analysis.

RESULTS

All adipose volumes and BMI were significantly correlated (p<0.001 for all). Adipose volume variables from VAT, SAT and TAT, and BMI were positive correlated with systolic BP and mean BP (p<0.05 for all). Additionally, adipose variables from VAT were positive correlated with BG (p<0.05 for all), as well as MRSAT and HG (p=0.048). GLM revealed that BMI was associated with BG (p=0.01), high BG (p=0.005) and systolic and mean BP (p<0.001). In the GLM of adipose variables, VAT, SAT and TAT were associated with high BG, systolic BP, mean BP, high BG, HTN, IR and HG(p<0.05 for all).

CONCLUSION

While both BMI and adipose volume measures was associated with BG, high BG, and systolic and mean BP using GLM in our sample, volumetric measures of adipose tissue from abdominal CT were better indicators of HTN, HG and IR than BMI alone.

CLINICAL RELEVANCE/APPLICATION

Volumetric measures of adipose tissue from imaging studies, such as CT, may identify risk factors for clinical conditions associated with obesity with higher precision than the popular BMI.

PDS237

Incremental Value of MR Cholangiography in the Diagnosis of Biliary Atresia (Station #6)

Siyoun Sung MD (Presenter): Nothing to Disclose, Tae Yeon Jeon MD: Nothing to Disclose, Ji Hye Kim MD: Nothing to Disclose, So Young Yoo MD: Nothing to Disclose, Hong Eo: Nothing to Disclose, Weekyoung Kim MD: Nothing to Disclose

PURPOSE

To evaluate the incremental value of MR cholangiography (MRCP) in combination with US compared with US alone for diagnosing biliary atresia in patients with cholestasis.

METHOD AND MATERIALS

Fifty-six neonates and young infants with cholestatic jaundice (mean age, 65 days; male to female ratio, 19:37) were enrolled. All patients underwent both MRCP and detailed US studies. Biliary atresia (n=41) was confirmed with surgical cholangiography, and hepatitis (n=15) was diagnosed with clinical improvement during the follow-up (n=14) or surgical cholangiography (n=1). Two observers independently reviewed a set of US alone and a combined set of MRCP and US, and rated them by a five-point scale. Diagnostic performance was compared using pairwise comparison of the receiver operating characteristics (ROC) curve. Sensitivity, specificity, accuracy, positive predictive value, and negative predictive value (NPV) were assessed.

RESULTS

The diagnostic performance (area under the ROC curve [Az]) to diagnose biliary atresia improved significantly after additional review of MRCP images; Az improved from 0.693 to 0.921 (P=.021) for observer 1 and from 0.648 to 0.888 (P=.005) for observer 2. The accuracy of MRCP combined with US (observer 1, 95% [53 of 56]; observer 2, 93% [52 of 56]), and NPV (observer 1, 93% [13 of 14]; observer 2, 92% [12 of 13]) were significantly higher than those of US alone (accuracy: observer 1, 77% [43 of 56], P=.021; observer 2, 73% [41 of 56], P=.007; NPV: observer 1, 57% [8 of 14], P<.001; observer 2, 50% [7 of 15], P<.001).

CONCLUSION

The combination of MRCP and US yielded better diagnostic performance to evaluate biliary atresia than US alone.

CLINICAL RELEVANCE/APPLICATION

Addition of MRCP to US can improve reader confidence in establishing a final diagnosis of BA and it may be helpful when the probability of US alone is intermediate results.
Three-dimensional Cardiac Image of Congenital Heart Disease in Neonate and Infant: Optimal Enhancement Method and Ultra-high Pitch Scan of Dual Source CT Make It Possible to Reconstruct Finer Three-dimensional Image and Preoperative 3D Models (Station #7)

Masahiro Kobayashi MD (Presenter): Nothing to Disclose, Nobuyuki Shiraga MD: Nothing to Disclose, Keiko Matsumoto: Nothing to Disclose, Kenichi Suzuki: Nothing to Disclose, Hideaki Suzuki MD, PhD: Nothing to Disclose, Eiichi Kohda MD: Nothing to Disclose

TEACHING POINTS
How to obtain good data to reconstruct finer 3D cardiac images in neonate and infant with congenital heart disease (injection route, scan timing, mode of dual source scan, iteration strength, radiation exposure, etc), according to their shunt types (cardiohemodynamics). To understand important and rare congenital heart diseases and their embryology with three-dimensional images. To understand and evaluate post operation changes, including complications for main surgical procedures.

TABLE OF CONTENTS/OUTLINE
A: CT protocols of dual-source CT for congenital heart disease (CHD) according to their cardiohemodynamics B: Pathophysiology and embryology of CHD such as TOF, TAPVR, TGA, etc C: CT images (two and three-dimensional) D: Outcomes (3D printer models for operation and post-operative status evaluation, including complications)

"Back from the Edge": Imaging of Extra-corporeal Membrane Oxygenation in the Paediatric Population—A Pictorial Review (hardcopy backboard)

Gillian Susan Cassels MBChB, FRCR (Presenter): Nothing to Disclose, Emily Jane Stenhouse MBChB: Nothing to Disclose, Greg Irwin MBChB: Nothing to Disclose, Daniel Hefferman-Ho: Nothing to Disclose, Gregor Walker: Nothing to Disclose, Mark Davidson: Nothing to Disclose, Susie Joy Goodwin MBChB, MRCS: Nothing to Disclose

TEACHING POINTS
1. To review indications for neonatal and paediatric ECMO therapy 2. To illustrate the range of arterial and venous cannulae used in paediatric ECMO 3. To discuss the normal radiologic appearances during paediatric ECMO therapy 4. To illustrate some of the radiologic appearances arising from the complications of paediatric ECMO with examples from our institution

TABLE OF CONTENTS/OUTLINE
ECMO (extra-corporeal membrane oxygenation) is a modified cardiopulmonary or pulmonary bypass therapy for neonates and children with cardio-respiratory or respiratory failure. The aims of this educational exhibit are to review current indications for ECMO therapy in children, to illustrate the range of cannula appearances and radiological position and to illustrate the range of complications encountered during ECMO therapy with imaging examples from our institution over a 22 year period. Background Review of indications Normal cannula position and appearance Imaging of Complications Role of Imaging Summary/Conclusions

PHS-TUA
Physics Tuesday Poster Discussions

PHS153
Calibration of Coronary Volume Calcium Score Using Iterative Image Reconstruction (AIDR 3D) at 120, 100 and 80kVp instead of the Reference Protocol (FBP at 120kVp). (Station #1)


PURPOSE
We performed a phantom study to calibrate the Volume calcium score using Adaptive Iterative Dose Reduction (AIDR 3D) at 80, 100 and 120kVp instead of Filtered Back-Projection (FBP) at 120kVp (reference protocol).

METHOD AND MATERIALS
ECG-gated volume scans of an anthropomorphic thoracic phantom containing 200, 400 and 800mg HA/cm³ calcium spheres of 1, 3 and 5mm diameter were performed on two 320-row CT`s (Aquilion ONETM (CT1)/Aquilion ONETM ViSION ED. (CT2)). Using 32 dose steps with 120kVp (CT1) for FBP, with 120/100kVp
(CT1) and 80kVp (CT2) for AIDR 3D reconstructions, the lowest volume CTDI values that provide accurate volume scores were determined for these 4 groups. The score averages and standard deviation (σ) were calculated over all included dose steps. The CT number thresholds for calcium identification were calibrated as follows. First, the scores were determined using thresholds between 120-160HU for 100kVp and 130-175HU for 80kVp. Secondly, a linear regression of the score averages was performed to determine at which CT number the reference score is crossed. Using these calibrated CT number thresholds, the score averages of the 4 remaining groups were statistically tested for 3σ-outliers, for normal distribution by Kolmogorov-Smirnov test and for statistical difference between the 4 groups by Kruskal-Wallis test. The 4 groups were finally averaged and with the 2σ-standard deviation graphed by Bland-Altman plot.

RESULTS

The CT number thresholds were calibrated to be 130HU (120kVp), 132HU (100kVp) and 140HU (80kVp) for the AIDR 3D groups and ensure an equivalent score average with 585.8±9.9mm³ (p=0.417) of the 4 groups compared to 585.5±9.7mm³ of the reference protocol. By using AIDR 3D instead of FBP reconstruction, radiation exposure can be potentially reduced with 69% (120kVp), 73% (100kVp) and 83% (80kVp). The related pixel noise threshold were determined for FBP with 26HU (120kVp) and for AIDR 3D with 23HU (120kVp), 23HU (100kVp) and 31HU (80kVp).

CONCLUSION

Volume scoring can be performed at reduced kVp levels in combination with AIDR 3D using kVp specific calibrated CT number thresholds.

CLINICAL RELEVANCE/APPLICATION

By applying iterative reconstruction and lower kVp, considerable radiation dose reduction can be achieved for Volume calcium score with good accuracy compared to reference protocol. This approach should be clinically validated.

In Vivo Determination of Human Radius Ca/P Ratio Using X-Ray Dual Energy Method (Station #2)

Panagiota Sotiropoulou : Nothing to Disclose, George Fountos : Nothing to Disclose, Niki Martini : Nothing to Disclose, Vaia Koukou : Nothing to Disclose, Christos Michail MSc (Presenter) : Nothing to Disclose, Ioannis Kandarakis : Nothing to Disclose, George Nikiforidis PhD : Nothing to Disclose

CONCLUSION

Compared with previous results, this method, based on energy resolving detector, can achieve better precision and accuracy in Ca/P bone mass ratio determination. Furthermore, this method, although it was tested preliminary in bone phantoms it can be applicable to patients, and can be used to follow-up skeletal disorders contributing to the diagnosis and treatment of osteoporosis.

Background

Osteoporosis is a disease characterized by low bone mass and structural deterioration of bone tissue, leading to bone fragility and an increased susceptibility to fractures, especially of the hip, spine, and wrist. Several invasive and non-invasive methods are available for measuring the bone mineral status. Dual energy methods have been used for osteoporosis diagnosis. In this study, an X-ray Dual Energy (XRDE) method for bone quality assessment by the in vivo determination of Calcium to Phosphorus (Ca/P) mass ratio, using an energy discriminative photon counting detector, was performed.

Discussion

Repeated measurements of each bone phantom provided an average 2% of Coefficient of Variation, revealing a precision able to distinguish differences in Ca/P mass ratio which ranges from 1.3 to 2.2 in adult human bone. The accuracy of the method was less than 3%.

Evaluation

A linear Cadmium Telluride (CdTe) detector was combined with a narrow pencil X-ray beam, suitably modified by filtration, to obtain transmission data from low- and high- energy bands. Three bone phantoms, simulating human radius, of different powders and Ca/P mass ratios, were used in order to determine the precision and accuracy of the method. The bone phantoms were irradiated with a 1300 µm Cerium (Ce) filtered X-ray, 100kVp spectrum, providing 38 and 86kV for the low- and high- mean energies, respectively. The precision and accuracy of XRDE method were evaluated by repeated measurements on bone phantoms.

Ultra-fast One Click Organ Dose Calculation Software Using Monochromatic Imaging in Dual-energy CT Scans (Station #3)

TOMOKAZU SHOHJII (Presenter): Nothing to Disclose, Norio Nakata MD : Nothing to Disclose, Sosuke Higuchi RT : Nothing to Disclose, Atsushi Tachibana MSc, RT : Nothing to Disclose, Yoh Katoh RT : Nothing to Disclose

PURPOSE

This software was developed to calculate organ dose from computed tomography (CT) value per pixel using monochromatic imaging created by dual-energy scans.
METHOD AND MATERIALS

The CT system used was SOMATOM Flash (Siemens AG). A combination of 80 and 140 kV was used as the scan condition to create 80-keV head monochromatic images. Next, the CT value/linear attenuation coefficient transformation formula at 80 keV was derived using Catphan module, in which substances with a linear attenuation coefficient for each kind of energy as immediate values were embedded. The transformation formula was subsequently transformed to generate linear attenuation coefficient images by superimposing it on CT value images. Finally, each pixel dose was calculated by filtered back projection and using the strength distribution of the X-Y surface, reflecting the X-ray strength of a bowtie filter as well as linear attenuation coefficient images. Then, the value registered on the glass dosimeter (GD-352M) inserted into a head phantom was compared with the calculated value.

RESULTS

Calculate dose of lens, salivary glands, oral cavity, cerebellum, and cerebral, was higher than the measurement dose of the glass dosimeter. The margins of error between the measurement dose and the calculate dose were maximum 10%.

CONCLUSION

Calculate doses are in good agreement with the measurement dose. By using this software, it is possible to obtain organ absorbed dose from monochromatic CT imaging with one click. And this software is useful for the evaluation of organ high cancer risk and children.

CLINICAL RELEVANCE/APPLICATION

This software is useful for the evaluation of organ high cancer risk and children.

A Novel Technique for Optimizing Dose Fractionation Regimen Based on the Universal Survival Curve with Tumor Repopulation (Station #4)

Yasutaka Sugano (Presenter): Nothing to Disclose, Masahiro Mizuta : Nothing to Disclose, Seishin Takao : Nothing to Disclose, Hiroki Shirato MD, PhD : Nothing to Disclose, Kenneth Sutherland : Nothing to Disclose, Hiroyuki Date : Nothing to Disclose

ABSTRACT

Purpose/Objectives:
Radiotherapy on solid tumors has been performed by various fractionation regimens such as multi- and hypo-fractionation. However, the investigation to optimize the fractionation regimen considering the physical dose distribution remains insufficient. We propose a mathematical method for selecting the optimal number of fractions ($n$) and dose per fraction ($d$) based on the physical dose distribution.

Materials/Methods:
This study adopts the universal survival curve (USC) with tumor repopulation to evaluate the effect on tumor and damage to organ at risks (OARs) in radiation exposure. The USC model provides a rectilinear description of the survival curve in the high dose range while preserving the quadratic nature of the linear quadratic (LQ) model in the low dose range. The essential point in radiation therapy is that the tumor be sterilized to a requisite level while normal tissues or OARs are preserved intact as much as possible. By using a graphical tumor-OAR (TO) plot to illustrate the relationship between the effect on tumor and damage to OARs, the optimal fractionation regimen was sought. For simplicity, we considered $n$-time irradiation with the same dose $d$ per fraction (1 fraction/day).

Results:
We defined the proportionality factor $\delta$ for representing the dose ratio of OAR to tumor. It was found that if $\delta$ is given, the optimal value of number of fractions ($n$) and dose per fraction ($d$) can be derived from the TO plot. For example, the optimal fractionation regimen (for the surviving fraction of the tumor to be fixed at 0.001%) is $n=39.6$ and $d=2.0$ [Gy] when $\delta$ is 0.8, and $n=5.5$ and $d=8.2$ [Gy] when $\delta$ is 0.1, under the assumption that the $\alpha/\beta$ ratios of tumor and OAR are 10 and 2 respectively, and the doubling time is 10 days.

Conclusions:
Our investigation showed that it is possible to determine the optimal number of fractions and dose per fraction corresponding to the physical dose distribution. This concept may stipulate a new guideline for radiotherapy planning.

CT X-ray Tube Output Changes Over Time (Station #5)

Yusuf Emre Erdi DSc (Presenter): Nothing to Disclose, Usman Mahmood MS : Nothing to Disclose

PURPOSE

It has been a well known fact that x-ray tube output decreases over time due to tungsten buildup on the exit window or anode surface roughening. However, the amount of output reduction has not been quantitated before. This work aims to measure CT x-ray tube output during its life-cycle.

METHOD AND MATERIALS

Twenty-eight (20 General Electric (Waukesha, WI) and 8 Philips (Andover, MA)) CT scanners have been included in this analysis. GE scanners (LS-16, VCT, HD 750) were mainly used for diagnostic radiology and PET/CT scanning with high patient loads (15-30 patients/day). Philips scanners (Brilliance, Precedence, Brightview) were in radiation therapy planning and SPECT/CT with low patient loads (<10 patients a day). The
x-ray tube outputs have been followed since acceptance testing and, with a tube change, the measurement cycle re-starts. Dose was measured using a PMMA head CT phantom manufactured by RadCal (RadCal, Monrovia, CA). The measurement system was a 9095 multipurpose analyzer with 10x9-3CT ion chamber both from Radcal. The ion chamber is inserted into the peripheral and central axis locations, and CTDIvol is calculated as weighted average of doses at those locations. All dose measurements were performed in axial mode.

RESULTS

None of the 40 GE tubes made it into their 5th year and only 1 Philips tube lasted after 4 years of clinical service. Dose measurements performed 1 year after tube replacement showed that both GE (1.89%) and Philips (1.52%) tubes had less than a 2% decrease in tube output. For the tubes that lasted at least 2 years, the decrease in radiation output was 5.15% for GE and 1.78% for Philips. Four years after tube replacement, the radiation output decreased by 10% for GE and by 3% for Philips tubes. A Philips tube, which has been in service for 7 years, has not shown any decrease in radiation output.

CONCLUSION

Depending on the CT x-ray tube age, radiation output can be reduced by up to 10%, which will translate into the increase of noise in clinical images unless compensated by an AEC system. For optimum clinical practice, it helps to know the age of the tube and increase tube current or scan time accordingly to compensate for the reduced x-ray tube output.

CLINICAL RELEVANCE/APPLICATION

CT x-ray tube output decreases over time. When quantitated, it is possible to compensate this decrease by increasing the tube output so image quality stays constant.

PHS159

Use of Optimal Respiratory Gating with Continuous Bed Motion PET/CT to Improve Personalized Radiation Therapy Planning (Station #7)

Dustin Osborne (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The purpose of this work is to assess the potential of advanced amplitude-based gating techniques with continuous bed motion PET/CT to improve the use of dose painting in regions where there exists a high probability for motion artifacts. The hypothesis is that advanced amplitude-based gating techniques used in conjunction with continuous bed motion PET/CT imaging will enable increased visibility of lesion topography that may indicate regions that could benefit from special treatment during radiation therapy planning. This study uses an amplitude-based gating method known as optimal respiratory gating that examines the respiratory cycle and chooses data points where the least amount of motion was observed during the scan time.

Materials/Methods: A patient with suspected lung cancer was imaged for initial staging using PET/CT. The patient was fitted with a standard respiratory belt for recording the respiratory cycle during the imaging sequence. Following the scan, data were processed as a standard PET/CT image and using optimal respiratory gating. Both image sets were sent to radiation therapy planning software for assessment and for drawing of dose contours. Countours were drawn for both the standard PET/CT images as well for the images created using optimal respiratory gating.

Results: Images reviewed using standard PET/CT indicated a large lesion with a small necrotic core of dimensions 2.4 cm x 1.1 cm x 1.3 cm. This necrotic center was not large enough to draw accurate contours or warrant additional review for customized radiation therapy planning and so the entire tumor volume would have been treated to 100% dose. The images processed using optimal respiratory gating showed a significant increase in the size of the necrotic core measuring 2.6 cm x 2.7 cm x 2.4 cm. This indicated a dramatic increase of over 4x the measured volume of the necrotic core using standard PET/CT. This increase in the size of the necrotic area of the lesion enabled accurate contouring of the area so that a customized dose plan could be applied to the motion affected region. For contoured regions inside the designated necrotic area, delivered dose was increased to 130%. Data showing the change in image quality and contoured regions will be shown.

Conclusions: Use of optimal respiratory gating enables improved image quality by significantly reducing the impact of motion on PET/CT images. These techniques enable visualization of motion-free imaging that may lead to improved use of dose painting techniques in areas of significant motion and subsequently improved patient outcomes.

PHS160

Modeling for Prediction of CAD-assisted Ratings of Radiologists in Breast Mass Characterization: A Feasibility Study (Station #8)

Berkman Sahiner PhD (Presenter): Nothing to Disclose, Aria Pezeshk PhD: Nothing to Disclose, Xin He PhD: Nothing to Disclose, Wejie Chen PhD: Nothing to Disclose, Rongping Zeng PhD: Nothing to Disclose, Nicholas Petrick PhD: Nothing to Disclose, Frank W. Samuelson PhD: Nothing to Disclose

PURPOSE

To investigate the feasibility of modeling to predict radiologists’ computer-aided diagnosis (CADx)-assisted ratings based on their unassisted ratings and standalone CADx scores.

METHOD AND MATERIALS

Our data set consisted of radiologists’ malignancy ratings on a 101-point scale for breast masses on mammograms and ultrasound images without and with the use of a multi-modality CADx system. Ten breast radiologists provided ratings for 67 breast masses (35 malignant and 32 benign) in a fully-crossed design. We used radiologists’ unassisted ratings and standalone computer scores as predictor variables in linear regression models to predict the assisted ratings. We compared two methods for modeling: Method one used a single
radiologist’s data to predict another radiologist’s ratings, and method two used the average ratings of a training set of radiologists to predict the average ratings of the remaining set of test radiologists. In method two, the data set was randomly partitioned into sets of five training and five test radiologists 200 times. We used a ten-fold cross validation technique to partition the cases into training and test sets for each method. Separate models were developed for malignant and benign masses. The performance of each model was measured using the correlation coefficient (CC) between the predicted and true assisted ratings.

RESULTS

For models trained with a single radiologist, the average CC values were 0.86 (range: 0.57-0.98) for malignant and 0.88 (range: 0.59-0.98) for benign masses. In comparison, for models trained with average ratings, the average CC values were 0.95 (range: 0.89-0.98) for malignant and 0.95 (range: 0.92-0.97) for benign masses. The average area under the receiver operating curve (AUC) obtained using the predicted and true average CAD-assisted ratings were 0.987 (se: 0.008), and 0.979 (se: 0.008), respectively. In comparison, the average AUC value obtained from the averaged unassisted ratings was 0.959 (se: 0.014).

CONCLUSION

Averaging the ratings of a group of radiologists allowed for the construction of accurate models for the prediction of ratings of a different group of readers. Using single-radiologist data for prediction resulted in lower accuracy.

CLINICAL RELEVANCE/APPLICATION

Most CADx systems are optimized based on standalone performance. Modeling radiologist-CAD interaction may result in improved optimization based on the predicted CAD-assisted radiologist performance.

PHS161

Ablation Zone Identification Using Multi-Gradient Echo MRI in Laser Focal Therapy for Prostate Cancer (Station #9)

Shiyang Wang PhD (Presenter): Grant, Koninklijke Philips NV / Aytekin Oto MD : Research Grant, Koninklijke Philips NV Consultant, Guerbet SA, Steffen Sammet MD, PhD : Research Grant, Koninklijke Philips NV, Weiwei Du : Nothing to Disclose, Milica Medved PhD : Nothing to Disclose, Gregory Stanislaus Karczmar PhD : Nothing to Disclose, Ambereen Yousuf MBBS : Nothing to Disclose, Jianing Wang : Nothing to Disclose

PURPOSE

MRI-guided laser ablation is becoming an important option for men with low-grade prostate cancer (PCa). However, improvements in imaging to guide ablation are needed. Contrast enhanced MRI cannot be used to evaluate lesions between ablations for the effect of heating on the stability of the contrast agent. Therefore we are testing use of multi-gradient echo (MGE) MRI to identify ablation zones and characterize effect of each ablation without contrast media injection. Data from MGE MRI were analyzed in the time domain to detect changes in water resonance peak height, frequency, and other characteristics that may be sensitive to cancer and changes produced by ablation, including hypoxia, hemorrhage, and edema.

METHOD AND MATERIALS

Five biopsy proven PCa patients were studied with IRB approval. MGE MRI was acquired in axial plane with free breathing (Philips 3T Achieva). Twenty echoes were acquired with ΔTE=3.2ms; resolution=2.30/2.3/3.8 mm; TR=1.7s; 23 slices; scan time 1.8 minutes. Five cancer and five normal ROIs were outlined by an experienced radiologist. The proton free induction decay in each voxel was Fourier transformed, the water resonance peak height (WPH) was measured and T2*map was calculated. Statistical significance was evaluated with two-way student t-test.

RESULTS

The average post-ablation water peak height decreased significantly compared with pre-ablation in cancer ROIs (p=0.029). T2* in lesions post-ablation was significantly shorter than T2* in normal ROIs (p=0.002). The ratio of WPH in normal tissue to WPH in cancer changes significantly after ablation (p<0.05) and the same is true for T2*. Fig. 1 A-B compares a post-ablation MGE image (TE=64.6ms) with a T1WI after contrast media injection. Figure 1C shows the difference between WPH images acquired pre- and post- ablation, and Fig.1 D shows the difference between T2*maps acquired pre- and post-ablation.

CONCLUSION

MGE MRI shows the ablation zone without the need of contrast injection. This allows repeated assessment following each heating period so that subsequent ablations can be optimized. In addition, changes in the water resonance lineshape or resonance frequency may provide information concerning effects of MRI-guided laser ablation.

CLINICAL RELEVANCE/APPLICATION

MGE MRI can provide useful information regarding the effect of ablation without contrast agent injection. This allows intra-treatment monitoring and optimization of the laser focal therapy procedure.

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CLINICAL RELEVANCE/APPLICATION

MGE MRI can provide useful information regarding the effect of ablation without contrast agent injection. This allows intra-treatment monitoring and optimization of the laser focal therapy procedure.
Quality control for mammography and tomosynthesis systems requires accurate measurements of dose, especially since these devices are or may be used for screening. Current dosemeters are mostly dependent on the incidence angle, the photon energy, backscatter and environmental conditions (pressure, temperature, etc). The purpose of this work was to evaluate the dependence of a new-generation, solid-state detector on these factors and test it for the practice of quality control.

Evaluation

The dosemeter is shielded on the back to avoid backscatter measurements and it is not dependent on environmental conditions, which is usual for solid-state detectors. To calibrate its dependence on x-ray beam incidence angle and energy, the dosemeter was sent to the national primary standard dosimetry laboratory. After calibration, the dosemeter was placed on a 46 mm-thick phantom to measure entrance surface air kerma from a digital breast tomosynthesis system (31 kVp and W/Al) at different levels of the tube current-time product.

Discussion

The dosemeter showed an angular dependence below 1 % for angles between 0 and 30 degrees (0.2, 0.1, 0.7 and 0.1 % for 8, 20, 26 and 30 degrees respectively), which contain the ones currently used in breast tomosynthesis examinations. Energy dependence was between 0.2 and 0.5 % for photon energies between 26 and 36 keV. During the measurements with the DBT system, the dose values displayed by the console and the dosemeter measurements showed no significant difference, which means that the dosimetry within the x-ray system was correct. An additional field comparison with measurements from an ionisation chamber is planned to be presented at the meeting.

CONCLUSION

The calibration measurements showed that the dependence on the angular beam incidence and the x-ray energy was below 1 %. The device can thus be used for the praxis of quality control in mammography and tomosynthesis. For this system, using the AEC settings, the dose from one mammography projection was similar to the dose received by one tomosynthesis scan.

Pseudocirrhosis as a Result of Aggressive Dose Modification (hardcopy backboard)

Primary: To increase awareness of a diagnostic pitfall in order to avoid over diagnosis of liver disease while utilizing low dose techniques.

Secondary: Review of the classic CT imaging characteristics of cirrhosis.

TABLE OF CONTENTS/OUTLINE

A. Classic imaging characteristics of cirrhosis on CT. B. Advantages and disadvantages of dose reduction techniques. C. Pseudocirrhosis: A description of new imaging entity seen during attempts to markedly reduce radiation exposure in CTPA and non-contrast vascular chest CT studies. - Description of findings seen on CT with sample cases. - Follow up imaging cases with separate modality (ultrasound or other) showing finding of cirrhosis to be false and an artifact of dose reduction techniques. D. Increase awareness of this particular diagnostic pitfall to avoid over diagnosis and to promote continued exploration and understanding of both the limits and advantages of dose reduction techniques.
 PURPOSE

The radiology report has been the primary means of communicating imaging findings to referring providers and more recently patients, but has seen little progression over the last several decades. Free-text reports allow radiologists to customize their descriptions of findings and introduce variability in the follow-up recommendations they issue. This creates potential confusion both for radiologists and for referring providers who may misinterpret the report language, the impact of which for follow-up is significant. Structured reporting improves the content and clarity of radiology reports for both referring providers and radiologists. An added benefit of structured reporting is the ability to mine reports for meaningful data. There are few standardized methods of communicating radiology findings and issuing recommendations for follow-up. The Breast Imaging Reporting and Data System (BI-RADS) is the most widely employed standardized reporting lexicon. BI-RADS has improved patient care through clear and consistent communication of breast imaging findings, while creating a system to identify and monitor patients requiring follow-up and to correlate BI-RADS scores to outcomes. There has been some movement towards the development of a standardized reporting nomenclature for other organs (e.g., Bosniak classification for renal cysts, Liver Imaging-Reporting and Data System (LI-RADS)), but none of these have yet been as universally adopted as BI-RADS. Modeled after BI-RADS, we created a standardized assessment codes for reporting focal masses in the liver, pancreas, adrenal glands and kidneys at our institution. This system, called Code Abdomen, has been created to improve communication with referring physicians and other radiologists and to facilitate identification of patients in whom follow-up imaging is required.

 METHODS

Radiologists use Code Abdomen to assign focal masses in the liver, kidney, pancreas and adrenals to one of eight categories/codes that summarize the overall level of concern for malignancy and the need for imaging or clinical follow-up. These four organs were selected due to the frequency with which masses are detected and followed in these organs as well as the impact on patient outcome. A significant strength of Code Abdomen is that it is applied to all cross sectional abdominal imaging examinations (CT, US, MRI) regardless of the indication or the examination or the setting (in or out patient, emergency department). An important feature of Code Abdomen is that it provides many codes to capture the clinical complexity of focal masses but can be easily classified into four categories: benign (1, 2, and 7), indeterminate (0 and 3), suspicious (4 and 5) and known cancer (6) (see figure). For indeterminate and suspicious lesions, we require radiologists to specify the modality and timing of follow-up. We introduced and adapted Code Abdomen in a staged rollout that began in July 2013. The first phase consisted of a 4-week “warm-up phase”, which included dedicated educational orientation sessions and hands-on guidance by the research team along with contributions of our colleagues led to the development of a set of frequently-asked questions (FAQs) which now serves as a resource in routine or atypical scenarios. Development of dashboards with automated e-mail reminder features to monitor has helped achieve high compliance rate by the radiologist. Given the scale of studies performed at our institution, an automated database was constructed to prospectively identify and track through the radiology information system (RIS) all patients with indeterminate or suspicious lesions as categorized by the lexicon.

 RESULTS

To date, we have used Code Abdomen on nearly 21,669 exams, corresponding to 15,258 patients. Educational orientation sessions and hands-on guidance by the research team have gradually improved monthly compliance rates among radiologists, with an average compliance rate of 82% across all eligible studies. Using the standardized lexicon has enabled us to determine that vast majority of focal lesions identified among the 4 organs are benign lesions, as expected. More importantly, the standard lexicon has allowed us to monitor our imaging studies prospectively to identify 1,751 patients with indeterminate lesions and 980 patients with suspicious lesions.

 CONCLUSION

Our Code Abdomen project represents a successful implementation of a standardized lexicon for reporting focal masses in the liver, pancreas, adrenal glands and kidneys. We have improved communication with referring physicians and other radiologists and facilitated identification of patients in whom follow-up is required. As with prior BI-RADS and LI-RADS experience, we expect Code Abdomen to evolve with input from radiologists, referring providers and eventually even patients. We will use the data to measure what we expect will be significant long-term improvement in the outcomes of our patients.

 QSE114

Using Psychometric Analysis to Improve Radiology Teaching Files and Objective Structured Clinical Examinations (OSCE) (Station #2)

Gerald J. Tan MBBS, FRCR (Presenter): Nothing to Disclose

 PURPOSE

Part of the continual assessment programme in our residency program includes an objective structured clinical examination (OSCE) conducted by an external agency. This consists of a set of 30 plain radiographs, of which approximately half contain an abnormality that might be found in an Emergency Department setting (e.g. pneumoperitoneum, or a scaphoid fracture), while the remainder are normal. To help the residents with their preparation, the department has a collection of teaching files. However these come from different contributors, leading to variations in the difficulty level and quality of these sets. This lack of standardisation leads the residents to ‘overcall’ abnormalities not just in the examination, but also in daily clinical practice.

 METHODS

The first step in improving consistency was to have a core faculty member vet the teaching files prior to release. However, we also wanted objective post-test feedback, particularly regarding reliability. Reliability is a measure of consistency and reproducibility, with a high reliability across sets implying that the resident would obtain a similar score regardless of which test set he or she took. We collected anonymized answer sheets from
The Ontario Provincial MRI Process Improvement Project Phase 3: Sustaining Continuous
liaisons resulted in successful engagement with hospital teams. Training sessions were conducted with over
The MRI PIP3 was able to successfully standardize MRI indicators and reporting processes implemented province
RESULTS
calculator, developed by the project team, which rated the data files on a scale of poor, fair, good, excellent. If
discrimination - Correlation between performance on an individual question against performance on the overall
examination. An item with good discrimination would separate the top performing candidates from the poorly
performing ones. Point biserial correlation - A numerical expression of item discrimination. Figure 1
demonstrates results of a sample analysis.

A total of 15 test sets (450 questions) were analysed, with 4-8 respondents per set (mean 6.6). Cronbach’s alpha
alpha ranged from 0.58 to 0.84 (median 0.73). An alpha of above 0.7 is generally accepted as demonstrating
good internal validity. Facility for all questions except one ranged from 0.57 to 1.0 (1 indicates an ‘easy’
question that all candidates answered correctly). Review of the single outlier question, which had a facility of
0.14, revealed an error in the answer key (it was coded as “normal” when in reality an abnormality was
present). Item discrimination was measured using point biserial correlation coefficients (PBS), which can range
from -1 to 1 (Higher values indicate a question that is better able to discriminate between high- and
low-performing candidates). PBS in our series ranged from 0.02 to 0.63. We used low (< 0.1) or negative
coefficients to identify questions for review. Facility scores were also used to identify questions that were “too
hard” or “too easy”. This served two purposes. First, we were able to standardize the difficulty level across the
different sets by shifting questions between sets, or by replacing questions (particularly those with low item
discrimination scores). Second, we were able to identify individual contributors who consistently set “too easy”
or “too hard” questions and provide them with objective, evidence-based feedback. Follow-up analysis of the
modified sets, with the next batch of residents, will provide feedback on whether these changes have improved
test reliability. Secondary measures of the impact of these changes would include residents’ performance on the
external examination, and subjective feedback from radiologists on residents’ performance under real-life
reporting conditions. Limitations included the small number of residents, which reduced the utility of evaluating
item discrimination graphically. We expect to overcome this problem as subsequent cohorts of residents use the
sets and total respondent numbers increase.

CONCLUSION
Basic psychometric analysis of our teaching sets was easy to perform, and yielded simple and easily-understood
metrics. We used these results to quickly identify a handful of questions for further review. This allowed us to
pick up errors in answer key coding, modify or remove ambiguous questions, and moderate the difficulty level
across various sets. We hope that this will improve test reliability and eventually translate to improved resident
performance in daily clinical work.
QSE134

Optimization of X-ray (XR) Based Protocol for the Detection of Retained Surgical Items (RSI) in the Operating Room (OR) (Station #4)

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, (Presenter), Officer, RaPID Medical Technologies, Gady Agam, PhD, Shareholder, RaPID Medical Technologies, LLC, Sameer Ansari, MD, PhD, Shareholder, RaPID Medical Technologies, LLC

PURPOSE

Quality assurance is one of the key points of the Affordable Care Act with an emphasis on prevention of errors and performance improvements. In 2012, the total number of surgeries in the US exceeded 110,000,000. RSI is any surgical tool or sponge inadvertently left in a patient’s body. Approximately two-thirds of RSI are surgical sponges, and another third represent mostly surgical needles and occasionally instruments. RSI are a high priority OR patient safety concern in the US with an incidence of 0.02-1% and classified as sentinel events by the Joint Commission. Morbidity and even mortality may result from direct injury, repeated surgery, or a prolonged hospital stay in addition to excess cost and loss of hospital credibility. To prevent RSI, patient safety measures include effective OR communication, mandatory counts of all surgical instruments and sponges, methodical wound examination, and XR of the surgical field before closing the wound. Miscounts occur in up to 12.5% of all surgeries, often requiring XR of the surgical field. Because up to 88% of RSI occur with "correct surgical counts", many hospitals mandate XR at the end of the complex surgeries. Although XR based protocols are critical for RSI detection, they are limited by the sensitivity of human eye, lack of formal training for RSI detection, and time duration for complete analysis. These limitations motivated us to improve protocol performance by optimizing the efficiency of key steps including communication, acquiring the XR in the operational field, uploading images to the picture archiving and communication system (PACS), and image analysis. We also developed a beta prototype for computer assisted detection (CADe) software for the detection of RSI, implementing it for the detection of the ray-tec sponge.

METHODS

We utilized business process modeling (BPM) methods and focused on process functionality, properties, and quality in the OR workflow. These inputs were analyzed to provide guidance for protocol engineers and application developers and develop more effective protocols. For the development of CADe software, we utilized advanced coding languages and algorithms that included image enhancement designed for RSI detection by removing artifacts and increasing contrast, candidate detection using machine learning and spatial clustering, feature extraction and selection for RSIs recognition, and RSIs classification system.

RESULTS

XR protocol was optimized by recommending using XR plates with wi-fi capabilities for faster upload of the image to the PACS, specific settings (kV and mAs) of the portable XR machine to provide optimal contrast for detection, usage of the preformed specific textual XR image denominators available on portable XR machines to improve communication, optimization of the PACS data flow that automatically default studies to a priority radiology workflow list, PACS integrated computer assisted detection (CADe) software to assist with image analysis, and effective critical information alert upon identification. Simulations of the optimized protocol on the OR phantom have showed detection rates approaching 99% with time to rule out RSI and findings reported back to the OR consistently within ≤2min upon XR acquisition. Testing of the beta prototype of the CADe software for ray-tec sponge detection in XRs at the optimal point of the receiver operating characteristic curve resulted in 99% specificity, 90% sensitivity, and 0.92 F-measure.

CONCLUSION

Implementation of BPM optimized XR protocols for RSI detection and with CADe software fully integrated into the PACS harbor the potential to increase OR time utilization, RSI detection rates, and patient safety in the ORs. In the environment where demand for surgical services has been been steadily increasing while margins are declining, BPM optimization of the radiology protocols to exclude RSI may streamline and automate processes, improve decision-making, and make better use of available resources - ultimately resulting in significant cost savings.

QSE003-b

PICC the Right Choice: Eliminating Central Line Placement Infections (hardcopy backboard)

Cindy Lehneretz, (Presenter): Nothing to Disclose, Chad Jeremy Fleming, MD: Nothing to Disclose, Michael John Withers, RT: Nothing to Disclose, Tiffany Craft: Nothing to Disclose, Sherrie Yerhot: Nothing to Disclose, Stacy S. Schultz, BA: Nothing to Disclose

PURPOSE

improve decision-making, and make better use of available resources - ultimately resulting in significant cost savings.
The purpose of this project was to decrease the prevalence of central line-associated bloodstream infection (CLABSI), within our interventional radiology practice at a large Radiology Department, from six to zero infections per year.

Central line-associated bloodstream infections occur in an estimated 250,000-500,000 patients annually. These cases have a 10-30% mortality rate and burden the healthcare system with an unnecessary $300 million to $2.3 billion a year. In 2007, our interventional radiology practice incurred six such infections within a 48-hour window of line placement. We surmised that changes to our practice should be implemented to decrease the loss of lives and reduce the financial burden associated with these preventable infections.

**METHODS**

Our team met over several days to discuss potential sources and prevention of central line infections. We had a nurse from our surgical services department perform aseptic technique audits which resulted in additional education and hand-on training to increase adherence to aseptic technique guidelines. Looking for the root cause of these infections, the team developed a fish bone diagram and through brainstorming sessions, reviewing the Centers for Disease Control and Prevention (CDC) guidelines, and discussions with our institution’s Infection Prevention and Control unit we came up with a four-fold solution. First, we changed our surgical prep solution from Betadine to Chlorhexidine to aid in the elimination of prevalent bacteria. Second, we changed to a surgical hand antiseptic containing Chlorhexidine Gluconate 1% Solution and Ethyl Alcohol 61% at the same time. Third, we adapted the use of an electric clipper instead of a straight blade razor. This reduction reduced the razor surface area on skin contact while simultaneously reducing patient skin nicks. Finally, we developed a central line placement antibiotic administration protocol and Central Venous Catheter Insertion Checklist. This is based on the Institute of Healthcare (IHI) Central Line Bundle. The bundle is a group of evidence-based interventions for patients with intravascular central catheters that, when implemented together, result in better outcomes than when implemented individually. The key components of the IHI Central Line Bundle are: Hand Hygiene, Maximal Barrier Precautions upon Insertion, Chlorhexidine Skin Antisepsis, and Optimal Catheter Site Selection, with Avoidance of the Femoral Vein for Central Venous Access in Adult Patients. This checklist is currently observable in all procedure rooms and is referenced both during and after all line placements. Finally, residents and fellows have access to a simulation center, wherein aseptic techniques are taught and practiced. The implemented changes to these procedures are demonstrated to the medical staff and allows for a streamlined and standardized technique.

**RESULTS**

These processes, although still in their infancy, were implemented in 2009. The infection prevalence for that year was reduced to one central line placement related infection. In the following four year period from 2010 to 2013, of the 9200 central lines placed, the number of central line placement blood infections within the aforementioned 48-hour window was reduced to zero.

**CONCLUSION**

Our department continues to practice these aseptic techniques and guidelines; hopefully we are able to maintain our current streak of perfect practice in the future.
The systematic approach and initiatives taken resulted in significant improvement in department's rating on attitude dimension of service excellence while other dimensions areas also register improvement. This also impacted the overall satisfaction positively. By December 2013 the rating on "Communication" improved by 3.6% (from 84% to 87%), "Attitude" by 28% (from 64% to 82%), "Responsiveness" by 3.5% (85% to 88%), and "Respect and Caring" by 2.4% (from 84% to 86%). The cumulative increase in service excellence rating was 8.9% (from 79% to 86%) while overall patient satisfaction rose by 4.5% (from 88.5% to 92.5%). Besides these measureable improvement, the meet-n-greet initiative not only prevented patients from unnecessarily wasting time before they are served but also resulted in faster patient movement subsequently improving department's efficiency. The practice was praised by hospital leadership and other areas (lab and clinics) also adopted the initiative.

**CONCLUSION**

Focused and systematic approach towards improving patient experience and satisfaction through instilling service excellence behaviors among staff and facilitating patients throughout their stay resulted in sustained improvements. While changing attitude is a challenging task, small and focused actions with continuous reinforcement help bringing the desired improvement.

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**Radiation Oncology Tuesday Poster Discussions**

**Sub-Events**

**ROS123 Intravoxel Incoherent Motion Magnetic Resonance Imaging Derived Parameters in Early Predicting Responsiveness of Neoadjuvant Chemotherapy for Locally Advanced Nasopharyngeal Carcinoma**

**Participants**

Moderator: John Christopher Grecula MD

Stockholder: Pfizer Inc

Stockholder: AstraZeneca PLC

Stockholder: Baxter International Inc

Stockholder: Bristol-Myers Squibb

Stockholder: Eli Lilly and Company

Stockholder: Medtronics

**Youping Xiao (Presenter): Nothing to Disclose**, Yunbin Chen MD: Nothing to Disclose, Jianji Pan: Nothing to Disclose, Zhuangzhen He: Nothing to Disclose, Ying N. Chen PhD: Nothing to Disclose, Wang Ren: Nothing to Disclose, Xiangyi Liu BS: Nothing to Disclose, Linfeng Cai BS: Nothing to Disclose, Weibo Chen PhD: Nothing to Disclose, Dechun Zheng MS: Nothing to Disclose

**Purpose**

To evaluate the intravoxel incoherent motion magnetic resonance imaging (IVIM-MRI) derived parameters in early predicting the responsiveness to neoadjuvant chemotherapy (NAC) for locally advanced nasopharyngeal carcinoma (NPC).

**Method and Materials**

From August 2012 to May 2013, IVIM-MRI with 14 b factors (0~1000s/mm²) performed on a 3.0 T MR imaging system (Achieva 3.0T, Philips Healthcare, Best, The Netherlands) was conducted on 56 consecutive patients with locally advanced NPC at the pretreatment and the 3rd day (day3), the 21st day (day21) after chemotherapy initiation. At the end of NAC, patients were classified into responders and non-responders according to the Response Evaluation Criteria in Solid Tumors (RECIST) based on MR measurement. The IVIM derived parameters (D, pure diffusion coefficient; f, perfusion fraction; and D*, pseudo-diffusion coefficient) were calculated twice by two experienced radiologists separately on an in-house software of IDL6.3 (Boulder, Chicago, USA) based on a bi-exponential algorithm model of IVIM theory. Their corresponding changes (Δparameter(dayX)(X=3 or 21)) were then compared between two response groups with Mann-Whitney U test. Interclass coefficient of variation (ICC) was applied to test the intra- and inter-observer measurement reproducibility. Statistical analyses were performed on SPSS 18.0. P<0.05 was considered significant.

**Results**

Finally, 48 patients (Stage III, 19 and Stage IV, 29) were recruited into the present study. 37 patients were categorized as responders after NAC. The intra- and inter-observer ICs of D, D* and f were excellent ranging from 0.949 to 0.978 and the coefficient of variances were small ranging from 1.92% to 26.01%. Significantly higher D and lower D* were observed at both day3 (P<0.05) and day21 (P<0.001) than pre-treatment. While no significant difference was presented on parameter f between them (P>0.05). By comparing to non-responders, responders presented notably larger ΔD, ΔD*, ΔD*3, ΔD*21 and Δf21 (P<0.05), while no significant difference was shown on Δf3 (P>0.1).

**Conclusion**

Locally advanced NPC presents characteristic changes of IVIM derived parameters after NAC, D and D* are more feasible than f in early predicting the chemotherapeutic response for NPC.

**Clinical Relevance/Application**

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IVIM parameters have a significant clinical application value and may help to optimize the chemotherapeutic regimens at the early stage of neoadjuvant chemotherapy for advanced nasopharyngeal carcinoma.

**ROS124**

**Outcomes of Spatially Fractionated GRID Radiation Therapy in the Treatment of Bulky Tumors (Station #2)**

Jehee Choi MD (Presenter): Nothing to Disclose, Tony Y. Eng MD: Nothing to Disclose

**ABSTRACT**

**Purpose/Objectives:** In this study, the authors performed a single-institution retrospective analysis of outcomes of patients with bulky malignant tumors treated with spatially fractionated GRID radiotherapy (SFGRT). Tumor response, symptom control, therapy tolerance, and acute toxicity were evaluated.

**Materials/Methods:** Patients treated with SFGRT between 1976 and 2013 were identified. The medical records of these 13 patients from 2007 to 2013 were reviewed. All patients presented with bulky tumors in the head and neck region, the majority of which were of squamous cell carcinoma histology, others including anaplastic carcinoma, poorly differentiated invasive carcinomas, and MPNST. Patient ages ranged from 13 to 83 years. All were planned to receive conventionally-fractionated EBRT to follow SFGRT, with a wide variety of dose prescription and fractionation schedules. SFGRT was delivered over one fraction of either 15 Gy or 20 Gy, using multileaf collimation.

**Results:** Of 13 patients, 12 were being treated for palliation of local tumor symptoms to include bleeding, restricted motion from tumor bulk, and pain. 8/12 patients (67%) experienced symptom improvement during the course of therapy. Average maximum tumor diameter was 10 cm. Substantial decrease in tumor size was observed in 6/10 patients (60%) being treated primarily for this purpose, with greater than 50% size reduction in patients with this follow-up data available. Of the 4 patients without tumor shrinkage, 2 patients received a curtailed course of EBRT or relatively low dose of EBRT, while a third had a long treatment break secondary to bleeding. 1 patient being treated definitively received chemotherapy concurrently and had substantial reduction in mass size. All tumor histologies responded to treatment with the exception of anaplastic carcinoma. RTG grade III skin or mucous membrane toxicity was seen in 4 patients, while grade IV toxicity developed in 4 patients, with bleeding or ulceration. One patient required tumor embolization secondary to uncontrolled bleeding.

**Conclusions:** Our single-institution review suggests that SFGRT is an effective radiation therapy modality for large, symptomatic tumors that can provide timely improvement in patient quality of life. At initial analysis, the toxicity associated with SFGRT does appear to be substantial. However, given that these tumors generally compromise skin and blood vessels in the proximity at presentation, these adverse effects can be considered the result of normal tumor biology, rather than treatment toxicity. The use of this modality of therapy is relatively limited, likely in part due to the small body of data available regarding its efficacy and safety of delivery. With this study, we provide added perspective to practitioners, possibly leading to increased application of SFGRT in the clinical setting for patients with these unique presentations.

**ROS126**

**Long Term Life Expectancy for Common Pediatric Central Nervous System Malignancies: Ependymoma And Medulloblastoma (Station #4)**

Jonathan Frandsen (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose/Objectives:** To ascertain the potential long term survival in disease-free pediatric patients with medulloblastoma (MB) or intracranial ependymoma (IE) who have survived past an average recurrence time frame of five years. Materials/Methods: Retrospective analysis was conducted using the Surveillance, Epidemiology and End Results (SEER) Program. Children (ages 0-19 years) from 1973 to 2010 with a diagnosis of MB and IE were identified, and patients with a known treatment status who underwent surgery and/or radiation were selected. A cohort was then created of potentially cured patients who survived five years from diagnosis. Kaplan Meier survival estimates were then utilized to model long term survival within this cohort. Results: We identified 745 patients with MB and 399 patients with IE who received surgery and/or radiation and were alive at five years. Patients with MB alive at five years had a 15-year and 30-year overall survival (OS) of 83% and 68%, respectively. Median survival was not reached at 37.6 years. Mean survival was 29.3 years (95% CI 28.8-31.1). Patients with IE alive at five years from diagnosis had a 15-year and 30-year OS of 80% and 53%, respectively. Median survival was 30.75 years (95% CI 27.8-33.7). Mean survival time was 27.4 years (95% CI 25.7-29.1). Patients with MB alive at five years had a 15-year and 30-year Cancer Specific survival (CSS) of 86% and 78%, respectively. Patients with IE alive at five years had a 15-year and 30-year CSS of 82% and 66%, respectively. Conclusions: Life expectancy after the first 5 years of survival for patients with MB and IE are promising. While recurrences still occur, the potential for a normal life span still exists in potentially cured patients.

**ROS127**

**Analysis of The Relationship between Dose Inhomogeneity and Local Control in Patients with Prostate Cancer Treated with Permanent Seeds Brachytherapy (Station #5)**

Fumitaka Ito MD (Presenter): Nothing to Disclose, Hidetoshi Kobayashi MD, PhD: Nothing to Disclose, Yumi Oie: Nothing to Disclose, HideKazu Hattori MD: Nothing to Disclose, Hiroshi Toyama: Nothing to Disclose, Masayuki Ito: Nothing to Disclose

**ABSTRACT**

Purpose: Excellent biochemical relapse free survival with low dose rate 1-125 brachytherapy for patients with early prostate cancer is demonstrated. Dose escalation may be feasible, but the balance between tumor control and normal tissue damage is critical to outcome and morbidity. Dose delivered to 90% of prostate is reported to be closely correlated with outcome. Low delivered dose is one of the origin of recurrence, so inhomogeneity is suspected to be important predictor. In this paper, the relation between biochemical failure free survival and dose inhomogeneity were evaluated. Material and methods: Five hundred twenty nine prostate cancer patients were treated by permanent brachytherapy using 1-125 seeds from 2006 to 2012. PSA failure was determined according to the Phoenix definition. The prescription dose was: low risk 160 Gy, intermediate risk 200 Gy, and high risk 230 Gy. Conclusions: Our single-institution review suggests that SFGRT is an effective radiation therapy modality for large, symptomatic tumors that can provide timely improvement in patient quality of life. At initial analysis, the toxicity associated with SFGRT does appear to be substantial. However, given that these tumors generally compromise skin and blood vessels in the proximity at presentation, these adverse effects can be considered the result of normal tumor biology, rather than treatment toxicity. The use of this modality of therapy is relatively limited, likely in part due to the small body of data available regarding its efficacy and safety of delivery. With this study, we provide added perspective to practitioners, possibly leading to increased application of SFGRT in the clinical setting for patients with these unique presentations.
VIS235

**Sub-Events**

Participants

**Tue, Dec 2 12:15 PM - 12:45 PM**   Location: VI Community, Learning Center

**AMA PRA Category 1 Credits ™**

**Scientific Posters**

**IR**

**VA**

**AMAPRA Category 1 Credits ™**: .50

**Vis-TUA**

**Vascular/Interventional Tuesday Poster Discussions**

**Scientific Posters**

**ROS154**

**Local Control and Toxicity in Patients with Cervical Cancer Treated with 3D Conformal Brachytherapy (Station #8)**

Ezgi Oymak (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):** Treatment options in locally advanced cervical cancer unfit for surgery has evolved with the introduction of brachytherapy (BT). Improvements in BT reflect on treatment results, reaching 90% 5 year local control rates. Sophisticated techniques like 3D conformal BT are promising better tumor coverage with higher normal tissue sparing. The importance of treatment related toxicity is emerging. We analysed our local control rates and gastrointestinal (GI) and genitourinary (GU) toxicity results in cervical cancer patients treated with 3D conformal BT (CBT).

**Materials/Methods:** Between January 2008 and May 2011, 55 patients diagnosed with stage IB-IVA cervical cancer have been retrospectively analyzed. All underwent 50.4 Gy ERT with weekly concurrent cisplatin followed by computed tomography (CT) based 3D CBT consisting of 4 fractions of 7 Gy.

**Results:** Median age of the whole group was 58 (27 - 85) years. According to the FIGO staging, there were 4 (7%) IB, 1 (2%) IIA, 26 (47%) IIB, 7 (13%) IIIA, 12 (22%) IIIB and 5 (9%) IVA diseases. 50 patients (91%) had epidermoid carcinoma, whereas 5 (9%) had adenocarcinoma. Median follow up period for all patients and for those alive are 38.0 (5.4 - 73.6) months and 47.9 (36.1 - 73.6) months, respectively. Physical examination and imaging techniques including magnetic resonance imaging (MRI) or positron emission tomography (PET) were performed for each patient after the completion of the treatment. At the last check-up, 24 (44%) were alive and disease-free while 24 (44%) were alive with disease. 29 patients (52%) patients were lost; 24 (43%) due to the disease, while 5 (9%) were lost due to other causes. 2 and 5 year overall (OS) and disease-free (DFS) survival rates for all stages were 67%, 49% and 48%, 24%, respectively. 2 and 5 year local control (LC) rates were 74% and 56%. On multivariate analysis, tumor size >5cm, age =15,6 showed significantly lower local control. Toxicity was evaluated according to the RTOG CTCAE v3.0. 22 patients (40%) had late GI toxicity. Severe (grade >=3) late GI toxicity was seen in 11 (20%) patients; 1 had grade 3, 10 had grade 4 toxicity. Late GU toxicity was seen in 11 (20%) patients. 10 (18%) had severe (grade >=3) late GU toxicity; 8 with grade 3 and 2 with grade 4. On multivariate analysis, CTV, RD1 and RD2 (minimum doses of 1cc and 2cc of rectum) were statistically significant for grade >=3 GI toxicity.

**Conclusions:** 3D CBT is an effective option for local control of cervical cancer. Our results are comparable with the literature. Patients with bulky tumors and high SUVmax values at presentation fare worse in terms of local control. The effect of “learning curve” as well as lack of magnetic resonance imaging (MRI) based BT planning explains the toxicity rates, similar to the experiences stated in the literature. Further studies are necessary to evaluate recurrence patterns and dose escalation.

**VIS-TUA**

**Protection Against Radiation-induced Brain Tumors in Interventional Professionals (Station #1)**


**Purpose**

Individuals involved in interventional procedures are chronically exposed to ionizing radiation, the only unequivocal risk factor for developing intracranial neoplasms. A recent report identified 31 interventionalists who developed brain cancer with the concern that physicians performing interventional procedures have disproportionate left-sided brain tumors. This study was designed to evaluate the effectiveness of using a novel personal cranial radiation protection surgical cap as a means of reducing the risk of radiation induced cerebral neoplasms.

**Method and Materials**

Following IRB waiver disposable surgical caps containing various levels of protective lead-free radiation shielding (No Brainer -RADPAD, Kansas City, KS) were used to protect the cranium in one interventionalist and one assistant during multiple fluoroscopic procedures. Radiation monitoring during the fluoroscopic procedures was accomplished using real-time radiation detectors (UNFORS, Billdal, Sweden). Simultaneous monitor recordings were performed with radiation detectors positioned identically above and below the protective material at the level of the anterior left cranium (above the left eye). Four levels of radiation protection were tested (lead equivalency at 90 kVp): 1) Red - 0.375 mm, 2) Orange - 0.25 mm, 3) Yellow - 0.125 mm and 4) Blue - 0.07 mm.
RESULTS
A total of 34 patient procedures were completed. Average distance from the calvarium to the Image intensifier was approximately 1 meter. The interventionalist and the assistant reported that the surgical caps were minimally different from those typically worn for interventional procedures and there was no reported discomfort even after multiple hours (day long) wearing. Dose reductions for the procedures are as follows: Overall (92%), Red (100%), Orange (100%), Yellow (96%) and Blue (78%).

CONCLUSION
The "No Brainer" is aptly named, as this simple inexpensive approach to cranium protection is easy to use, comfortable and highly effective at decreasing brain radiation exposure. This device should stem the increasing number of interventionalists reported with cerebral malignancies.

CLINICAL RELEVANCE/APPLICATION
Comfortable disposable surgical caps containing a lead-free radiation protection barrier can serve as a means of reducing the risk of radiation induced cerebral neoplasms.

VIS236
Incidence of Significant Non-vascular Findings (Neoplastic and Non-neoplastic) in Patients Who Have Undergone Endovascular Aortic Aneurysm Repair (EVAR) (Station #2)
Mark Quentin Smith MD (Presenter): Nothing to Disclose, W. Brian Hyslop MD, PhD: Nothing to Disclose, Louise Michelle Henderson: Nothing to Disclose, Hyeon Yu MD: Nothing to Disclose, Julia R. Fielding MD: Nothing to Disclose

PURPOSE
To determine the incidence of clinically significant non-vascular findings on contrast-enhanced CT angiography in patients who have undergone EVAR.

METHOD AND MATERIALS
We retrospectively reviewed the radiology reports of the initial abdominopelvic contrast-enhanced 64-slice MDCT scans in 1000 patients who presented with an abdominal aortic aneurysm between January 1, 2008 and December 31, 2011. We followed the imaging results for a minimum of two years to determine the significance of each finding. Incidental findings that were benign or unlikely to undergo follow-up were placed into the low significance group. Benign findings that had the potential to warrant medical or surgical intervention were classified as having moderate importance. Findings that required specialized imaging, biopsy or therapeutic intervention as well as indeterminate findings were placed within the high significance category. We examined the proportion of incidental findings in each of these categories by age and location and calculated the 95% confidence intervals to assess differences among subgroups.

RESULTS
There were a total of 2374 incidental findings in 847 patients: 1877 were of low significance, 357 were of moderate significance, and 140 were grouped in the high significance category. There were no differences in the proportion within each category of incidental findings by age group (<65 versus 65+). Of the high significance findings, 32 incidental malignancies (3.2%, 95% CI: 2.3-4.5%) were found, with renal cell carcinoma being the most common (n=11), followed by metastatic disease (n=5). 22 of the 32 patients had N0M0 disease at initial staging.

CONCLUSION
Our rate of incidental cancers found on abdominopelvic imaging of 3.2% is low, but is greater than the 0.56-1.25% reported in virtual colonoscopy studies. This may be secondary to the older mean age of this population. In addition, contrast-enhanced scans allow for definitive diagnosis of malignant lesions.

CLINICAL RELEVANCE/APPLICATION
The presence of incidental cancers on endovascular CT angiography highlights the need for careful radiologic review of all vascular imaging studies.

VIS237
Realizing Radiation and Iodine Dose Reduction in Coronary CT Angiography by Using Adaptive Statistical Iterative Reconstruction (Station #3)

PURPOSE
To investigate the feasibility of low kVp and low iodine scan protocol in coronary computed tomography angiography (CCTA) to reduce radiation dose without undermining image quality.

METHOD AND MATERIALS
200 consecutive patients with body mass index (BMI) 20-25 kg/m² undergoing prospectively electrocardiogram-triggered CCTA were randomized into four groups at 4 sites. Group A: using 80kVp and ioxanol 270 mgI/mL with 60% adaptive statistical iterative reconstruction (ASiR); group B: using 100kVp and ioxanol 320 mgI/mL with 30-40% ASiR; group C: using 100kVp and iopromide 370 mgI/mL with filtered back projection. 60 ml contrast was given at 5 ml/s intravenously. CT values of 18 coronary artery segments were measured. Image quality was assessed by 2 experienced radiologists blinded to examination, using a 4-point scale (1-4: nondiagnostic-excellent). An assigned score of 1 in any segments was graded the image as nondiagnostic. Noise, contrast-to-noise (CNR), signal-to-noise ratio (SNR) and size-specific dose estimate (SSDE) were also calculated.

RESULTS

163 subjects completed study. CT values of all segments in all groups met clinical diagnostic requirement. There was no significant difference in image quality among the four groups (3.4 ± 0.7, 3.5 ± 0.5, 3.6 ± 0.4, 3.6 ± 0.3 respectively). The average CT value in group A (n=37) was higher than that in group B (n=45), C (n=40) and D (n=41) (all p < 0.05). Noise in group A (40.6 ± 8.5 HU) was significantly higher than that in group B (28.8 ± 6.7 HU), C (28.5 ± 4.6 HU) and D (29.1 ± 4.8 HU) (all p < 0.001), while CNR and SNR in group A was lower than that in group C and D (both p < 0.001). Compared with group D, the mean SSDE was reduced by 56.2%, 34.7%, and 34.3% in group A, B, C respectively.

CONCLUSION

All low kVp scans achieved a good image quality with significantly reduced radiation dose. 80 kVp with ioxanol 270 mgI/mL in prospectively electrocardiogram-triggered CCTA for patients with a normal BMI is practicable.

CLINICAL RELEVANCE/APPLICATION

With a prospective comparison, the study result has solidified the use of low tube voltage and low iodine enhancement in CCTA. It is time to promote 80 kVp CCTA protocol in clinical to benefit patients from 50% reduction of radiation dose.

VIS234

Prophylactic Temporary IVC Filter Retrieval following Major Spinal Reconstruction Surgery: Comparison between Scoliosis and Non-scoliosis Patients (Station #5)

Hilary A. Brazeal MD (Presenter): Nothing to Disclose, Jay Desai MD: Nothing to Disclose, Carlos Javier Guevara MD: Nothing to Disclose, Seung Kwon Kim MD: Nothing to Disclose

PURPOSE

Prophylactic IVC (inferior vena cava) filter placement was initiated for all ‘high-risk’ spinal surgery patients after a pilot study demonstrated decreased VTE-related morbidity and mortality. Given increased angulation of the IVC filter in patients with scoliosis, there is higher chance of IVC filter tilting, leading to increased difficulty of IVC filter retrieval. The purpose of this study is to compare filter retrieval between scoliosis and non-scoliosis patients who had temporary IVC filter placement before major spinal reconstructive surgery.

METHOD AND MATERIALS

Patients were identified by a computerized search of the radiology information system for prophylactic temporary IVC filter placement before major spinal reconstructive surgery and filter retrieval after surgery from 2005 to Jan 2014. These patients were divided into two groups: a scoliosis surgery (SS) group and a non-scoliosis surgery (NSS) group. Type of filter, attempted filter retrieval, indwelling time of filter, sedation time of the filter retrieval procedure, and success of attempted filter retrieval were compared between the two groups.

RESULTS

From 2005 to Jan 2014, 134 IVC filters were placed prior to spine surgery. 116 (84.9%) of those were retrievable filters. Retrieval was attempted on 53 (45.7%) of the retrievable filters. Retrieval was successful in 45/53 (84.9%) of those attempts, including a single case that was successful on the second attempt. Indwelling time of IVC filter at time of attempted retrieval was significantly higher in the SS group (SS group = 59.4 days, NSS group = 31 days) (p=0.006). Success rate of attempted filter retrieval in the SS group (78.1% (25/32)) was lower than the NSS group (95.2% (20/21)) (p=0.13). Average retrieval sedation time of a successful retrieval in the SS group (44.8 minutes) was higher than the NSS group (28.2 minutes) (p= 0.15). Type of filters in failed retrievals were Günther Tulip (4/25) and Option (4/17).

CONCLUSION

IVC filter retrieval requires increased procedure time and has decreased success rates in the SS group compared with the NSS group.

CLINICAL RELEVANCE/APPLICATION

Longer IVC filter indwelling time in scoliosis surgery patients leads to increased difficulty and decreased success of IVC filter retrieval.

VIS238

Transarterial Chemoembolization (TACE) as a Palliative Treatments Option for Liver Metastases from Lung Cancer: Indications, Outcomes and Role in Patient’s Management (Station #6)
PURPOSE

To evaluate local tumor control and survival data after TACE with three different chemotherapeutic protocols in the palliative treatment of patients with liver metastases from lung cancer.

METHOD AND MATERIALS

The study protocol was approved by the ethical committee, and informed consent was obtained from all patients prior to treatment. A total of 44 patients (mean age, 55.2 years; range, 42-78 years) with unresectable liver metastases of lung cancer who did not respond to systemic therapy were repeatedly treated with TACE in 4-week intervals. In total, 176 chemoembolization procedures were performed (mean, 4 sessions per patient; range, 3-6 sessions). The local chemotherapy protocol consisted of mitomycin alone (22.7%; n=10), mitomycin with gemcitabine (22.7%; n=10) or mitomycin, gemcitabine and cisplatin (54.6%, n=24). Embolization was performed with lipiodol and degradable starch microspheres. Local tumor response was evaluated by MRI according to the RECIST criteria. Survival data were calculated according to the Kaplan-Meier method.

RESULTS

The local tumor control was: partial response (PR) in 15.9% (n=7), stable disease (SD) in 56.8% (n=25) and progressive disease (PD) in 27.3% (n=12) of patients. The 1-year survival rate after chemoembolization was 70%, and the 2-year survival rate was 38%. The median and mean survival times from the start of TACE treatment were 20 and 31.8 months. There was no statistically significant difference between the three treatment protocols.

CONCLUSION

Chemoembolization is a potentially palliative treatment option in achieving local control in selected patients with liver metastases from lung cancer.

CLINICAL RELEVANCE/APPLICATION

Chemoembolization is a potentially palliative treatment option in achieving local control in selected patients with liver metastases from lung cancer.

VIE125

Popliteal Artery Entrapment Syndrome (PAES): Types and Dynamic Imaging Protocol (Station #7)

TEACHING POINTS

1. To describe normal anatomy of the popliteal fossa
2. Current classification of anatomic and functional popliteal artery entrapment
3. To assess weaknesses and strengths of different imaging modalities
4. Discuss emerging role of dynamic contrast enhanced CTA for diagnosing PAES.

TABLE OF CONTENTS/OUTLINE

- Normal anatomy of the popliteal fossa
- Anatomic versus functional popliteal entrapment
- Radiographic evaluation of PAES with Ultrasound, MRI/MRA and Angiography
- Dynamic CTA for suspected PAES: - Advantages - how we do dynamic scanning on CT
- Clinical cases

VIE101

Selective Internal Radiation Therapy (SIRT) – A Review on the Principle, Work-up and Overview of Published Data in Selective Internal Radiation Therapy with Yttrium-90 Microspheres (Station #8)

TEACHING POINTS

The incidence of both primary and secondary liver malignancies is increasing. Although surgery or minimally invasive intervention e.g. radiofrequency ablation results in the best outcomes, these approaches are limited by the burden and site of disease. Selective internal radiation therapy (SIRT) is a promising technique in patients deemed unsuitable for surgery. Despite its increasing popularity, radiologists may not be familiar with this treatment. Review the principle of SIRT with yttrium-90 (90Y) microspheres Review the literature with regards to treatment outcomes. Although morphological imaging is usually used to assess disease burden and treatment response, the potential for functional imaging techniques is discussed.

TABLE OF CONTENTS/OUTLINE

- Physics and biological basis of SIRT with yttrium-90
- Comparison of the properties of SIR-spheres with Theraspheres
- Patient selection/contraindications
- Patient preparation: visceral angiography (Fig. 1);
- hepatopulmonary shunt (Fig. 2 and 3);
- dosimetry
- Adverse reactions and complications
- Special consideration in patients with portal vein thrombosis and malignant biliary obstruction
- Morphologic and functional imaging techniques for response assessment and prediction (Fig. 4 and 5)
- Review of published data supporting use of 90Y-SIRT: response rate and long-term outcome
TEACHING POINTS

To present a guide to ultrasound (US) guided percutaneous injection of thrombin for the treatment of femoral artery pseudoaneurysms. To review the indications, technique, possible complications and limitations. To assess relevant guidelines in order to seek alternative treatment when this technique fails.

TABLE OF CONTENTS/OUTLINE

Description of predisposing factors for femoral artery pseudoaneurysm formation, clinical features and Doppler US diagnosis. Meticulous description of the technique, including step by step US guided femoral artery catheterisation, thrombin preparation and administration, variation of the procedure according to the size, form and number of the pseudoaneurysm's lobes. Specific points that should be kept in mind in order to maximise success rates and avoid complications. Outline of post procedure follow up, need for possible repetition of treatment and guideline flowchart in order to abandon the technique for surgical repair when needed are also explained. US images from our Institution's experience.
LEARNING OBJECTIVES

1) To familiarize radiologist with the general indications for 3D printing in biomedical imaging. 2) To learn the basic principles of an STL file. 3) To obtain "hands-on" experience in creating a STL file from radiology DICOM images. 4) To learn an approach to STL file manipulation to achieve a 3D printed model.

URL's

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

Active Handout

http://media.rsna.org/media/abstract/2014/14003456/RCB33sec.pdf

RCC33


Refresher/Informatics

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 12:30 PM - 2:00 PM  Location: SS01ABC

LEARNING OBJECTIVES

1) Understand the meaning and purpose of structured reporting and standard terminology. 2) Review the progress on RSNA's library of best-practices radiology report templates. 3) Discuss directions for further development of the report template library. 4) Learn how radiologists can use these reporting templates to improve their practice.

ABSTRACT

This session will review the RSNA-sponsored initiative to improve radiology reporting practices. The RSNA has created a library of over 200 exemplary report templates that contain reusable structured data based on RadLex® and other standard terminologies. These report templates represent best-practices that can be adopted by radiologists and adapted based on local practice patterns. The template library, available on the RSNA web site, serves as a resource for radiologists who wish to improve their practice by standardizing the format, content, and structure of their reports. Over the last 2 years, the RSNA has collaborated with IHE and DICOM to develop standards for radiology report templates that will provide new reporting capabilities. This session will provide an overview of structured reporting, review the progress of the RSNA-sponsored initiative, and describe how radiologists can take advantage of this effort to improve their clinical practice.

URL's


Sub-Events

RCC33A

The RSNA Reporting Initiative: Background and Status

Curtis P. Langlotz MD, PhD (Presenter): Shareholder, Montage Healthcare Solutions, Inc Advisory Board, Reed Elsevier Advisory Board, Activate Networks, Inc Spouse, Consultant, Johnson & Johnson

LEARNING OBJECTIVES

View learning objectives under main course title.

RCC33B

RSNA's Reporting Initiative: Accomplishments and New Directions

Charles E. Kahn MD, MS (Presenter): Shareholder, Hotlight Inc Officer, Hotlight Inc

LEARNING OBJECTIVES

1) Describe the RSNA Report Template Library and how radiologists can access its reporting templates. 2) Understand current efforts to integrate the RSNA's reporting templates into clinical practice. 3) Define a vision for reporting that will advance the specialty of radiology as a leader in data-driven healthcare delivery.

URL's

http://www.radreport.org/tour/

RCC33C

Using Templates from radreport.org: Benefits, Critiques and Solutions
Hologic: Essentials of 3D Mammography Self-Guided Training

Vendor Workshops

Tue, Dec 2 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 http://www.hologic.com/RSNAtomo-courses to register for this Vendor Workshop.

BRS-TUB

Breast Tuesday Poster Discussions

Scientific Posters

BR

AMA PRA Category 1 Credits ™: .50

Tue, Dec 2 12:45 PM - 1:15 PM  Location: BR Community, Learning Center

Sub-Events

BRS264

Histopathological Verification of BI-RADS Scoring Accuracy in Breast Ultrasound, Conventional Mammography and Contrast Enhanced Digital Mammography (Station #1)

Elzbieta Luczynska MD (Presenter): Nothing to Disclose, Sylwia Heinze-Paluchowska PhD : Nothing to Disclose, Sonia Dyczek MD : Nothing to Disclose, Pawel Blecharz : Nothing to Disclose, Jerzy Jakubowicz MD : Nothing to Disclose

PURPOSE

The main goal of this study was to compare the accuracy in BI-RADS scoring in breast ultrasound (US), conventional mammography (MG) and contrast enhanced spectral mammography (CESM) of histologically proven breast cancers.

METHOD AND MATERIALS

US, MG and CESM examinations were performed in 137 patients (mean age 58.3, range 26-82 years) who were referred from screening program. The study was approved by health authorities and institutional review board and all patients enrolled provided written informed consent. For obtaining the ultrasound images we used a Hitachi Preirus Hi Vision (Hitachi Medical, Tokyo, Japan) ultrasound system. Conventional mammography (MG) (Mammomat 3000, Siemens; Senographe Essential, GE Healthcare) was performed in all patients either within the institution or in other imaging centres. CESM examinations (GE SenoBright) were bi-lateral, craniocaudal and mediolateral views with dual-energy acquisition technique starting 2 minutes after IV injection of 1.5ml iodinated contrast agent per kg of bodyweight with a flow of 3ml/sec. Achieved images were assessed using BI-RADS classification (scale 1-5). All lesions visible in these examination methods were evaluated by two independent, experienced radiologists.

RESULTS

The highest accuracy of BI-RADS scoring was observed in CESM examinations - 100% lesions classified as malignant appeared to be a cancer. In US breast imaging correct BI- RADS scoring was assigned in 92% of patients. The lowest accuracy was noticed in MG - only 90% of described lesions were classified correctly. Tab.1 Distribution of malignant lesions in the studied group (BI-RADS classification)

CONCLUSION

The sensitivity of mammographic detection is reduced in women with dense breast and the presence of a non-calcified tumor might be undetectable especially if the mass is within a fibroglandular area. Although screening ultrasound could enable the detection of mammographically occult cancers and can be well visualized against a background tissue, our results showed, that CESM is a valuable diagnostic method that enables the most accurate BI-RADS classification of malignant breast lesions.

CLINICAL RELEVANCE/APPLICATION

Contrast Enhanced Spectral Mammography may provide higher BI-RADS scoring precision and greater...
Invasive Lobular Carcinoma (ILC) is difficult to detect and to evaluate the extent of the lesion in comparison with Invasive Ductal Carcinoma among breast cancer subtypes because of its diffuse growth. Digital breast tomosynthesis (DBT) is a useful diagnostic procedure compared to 2D mammography (MMG) because overlap of breast tissue is reduced by DBT. In this study, we evaluated the diagnostic usefulness of DBT for ILC in comparison with the other diagnostic modalities; 2D MMG and contrast-enhanced MRI (CE-MRI).

METHOD AND MATERIALS
Images from 32 patients (age 34-78yrs, mean 54.3yrs) who underwent 2D MMG, DBT and MRI from October 2009 to July 2013 and who were diagnosed with ILC based on surgical pathology specimens were retrospectively assessed. Items for imaging assessment were: 1. Comparison of detection capability according to 2D MMG and DBT. 2. The extent of the lesion according to 2D MMG, DBT, and MRI was compared to surgical pathology specimens, and statistical analysis was performed.

RESULTS
The rate of detection was 81.3% for 2D MMG and 100% for 2D MMG+DBT. Statistical analysis (using a paired t-test) revealed that adding DBT to 2D MMG significantly improved the ability to accurately diagnose the extent of the lesion compared to 2D MMG only (p<0.001, 95%CI -3.9 - -1.6). In addition, comparison of 2D MMG+DBT and MRI revealed no significant differences (p: 0.217, 95%CI -0.4-1.5), but extent of the lesion according to 2D MMG+DBT did deviate slightly from the extent of the lesion in surgical pathology specimens.

CONCLUSION
In diagnosing for ILC, adding DBT to 2D MMG resulted in improved ability to visualize tumor density, tumor margins, and architectural distortion in comparison to 2D MMG alone. Adjunction of DBT to 2D MMG is useful to detect and evaluate its extension in connection with ILC.

CLINICAL RELEVANCE/APPLICATION
Adjunction of DBT to 2D MMG improves capability both to detect and assess the extent of disease for ILC and helps to reduce false-negative and to determine the treatment planning.

System-Wide Monitoring of Mammographic Radiation Dose for Quality Assurance (Station #3)


PURPOSE
Interpreting large volumes of mammographic site data for quality assurance is complicated by differences in imaging systems and population characteristics. In this study, we used a novel system-wide approach to determine whether GE and Hologic mammographic units under- or over-estimated mean glandular dose (MGD) compared to a personalized estimate.

METHOD AND MATERIALS
Mammographic images (11,254 images; 2864 studies) from December 2006 to March 2014 were retrospectively analyzed in our practice using automated quality assurance software (VolpraAnalyticsTM). Volumetric breast density (VBD) characteristics and a personalized estimate of MGD (P-MGD) were obtained from the raw images. Facility and image data were automatically extracted from the image headers (e.g. manufacturer-reported MGD (M-MGD), detector ID and vendor). Average MGD values were compiled across individual mammography units (3 GE and 2 Hologic). Differences between P-MGD and M-MGD were assessed by mammography unit, vendor and patients’s VBD characteristics.

RESULTS
Overall, M-MGD significantly underestimated dose compared to the P-MGD (1.47 and 1.58 mGy, respectively; p=0.014). When stratified by vendor, the difference between M-MGD versus P-MGD estimates were 0.03 mGy (p<0.05) and 0.24 mGy (p<0.001) for the GE and Hologic units respectively. Subanalysis of one GE and one Hologic unit found that M-MGD and P-MGD estimates were very similar for the GE unit (1.44 and 1.46 mGy; p=0.381), but significantly different for the Hologic unit (1.60 and 1.84 mGy, respectively; p<0.001) despite similar VBD and breast volumes for both patient groups. The differences in vendor dose algorithms effectively masked some of the variation in dose between mammography units, albeit other influencing factors, such as compression, were also present.

CONCLUSION
Stratification of radiation dose data by mammography unit highlighted significant differences in MGD estimates.
between GE and Hologic units which can be attributed, in part, to the different dose algorithms used by each manufacturer. P-MGD estimates, which incorporate both individual breast densities and a manufacturer-independent dose algorithm, are essential for standardizing the assessment of radiation dose.

**CLINICAL RELEVANCE/APPLICATION**

In monitoring radiation dose, a system-wide approach incorporating breast density characteristics allows standardization of MGD between mammographic units, for improved breast imaging safety.

**BRS267**

**Diagnostic Accuracy of Breast MRI in the Evaluation of Patients with Suspicious Nipple Discharge. (Station #4)**

Valeria Casali (Presenter): Nothing to Disclose, Marianna Telesca MD: Nothing to Disclose, Simone Liberali: Nothing to Disclose, Elena Miglio: Nothing to Disclose, Ilaria Mussetto: Nothing to Disclose, Federica Pediconi MD: Nothing to Disclose, David Cannata MD: Nothing to Disclose, Rossella Di Miscio: Nothing to Disclose

**PURPOSE**

To investigate the role and the diagnostic accuracy of Breast Magnetic Resonance Imaging (MRI) in the evaluation of patients with suspicious discharge from the nipple.

**METHOD AND MATERIALS**

68 patients with suspicious nipple discharge underwent MRI using a 1.5T scan with the following protocol: pre-contrast T2-weighted TIRM sequences, T1 weighted 3D sequences acquired before and after gadobenate dimeglumine administration (Multihance 0.1 mml/Kg). MRI findings were divided according to BIRADS criteria into two groups: benign (BIRADS 1-2-3) and maligns (BIRADS 4-5). 42 patients underwent surgery, 26 patients were clinically and instrumentally followed-up during 24 months. Histological and clinical findings after 24 month were compared to MRI findings.

**RESULTS**

MRI identified 28 cases of BIRADS 4-5, 12 of which were found to be malignant at histological examination. In the 40 cases classified as BIRADS 1-2-3, 14 lesions were confirmed as benign by definitive histological examination, 2 lesions were found to be a malignant tumor and 24 patients had negative follow-up at 24 months. Sensitivity, specificity and diagnostic accuracy of MRI were respectively 93%, 92% and 92% with a positive predictive value of 87% and negative predictive value of 96%.

**CONCLUSION**

Breast MRI is an accurate method in the evaluation of patients with suspicious discharge from the nipple. A negative MRI can direct patients to follow-up rather than surgery.

**CLINICAL RELEVANCE/APPLICATION**

Breast MRI can be considered a diagnostic leader in patients with unexplained nipple discharge to distinguish malignant from benign lesion.

**BRS268**

**Using Computer-extracted Features from Tumors on Breast MRI to Predict Stage (Station #5)**


**PURPOSE**

One of the most important roles of imaging in women with breast cancer is to accurately predict stage in order to direct patients to appropriate treatment. Our goal in this study was to demonstrate that computer extracted features of biopsy-proven breast cancer (computer-extracted tumor phenotype-CETP) on MRI can accurately predict breast cancer stage.

**METHOD AND MATERIALS**

We used a retrospectively collected dataset of de-identified breast MRIs from multiple institutions organized by the National Cancer Institute (NCI) in a centralized repository called The Cancer Imaging Archive (TCIA) which includes outcomes collected from cancer center tumor registries. For each case, we characterized tumors on MRI by (a) qualitative semantic features from multiple radiologists’ interpretations and (b) automated
computerized image analyses (CTEP) including volumetrics, texture (homogeneity), and kinetics. We built a linear discriminant analysis model (LDA) to predict tumor stage and lymph nodes involvement on pathology. We evaluated each LDA model in turn by calculating a risk score for each patient (using cross validation); used this risk score to construct ROC curves; and compared the AUC of each model to baseline chance (AUC=0.5) using the DeLong method.

**RESULTS**

We analyzed a total of 98 biopsy proven breast cancer cases. Pathologic outcomes revealed: negative nodes (n=49), >1 positive node (n = 48; 1 missing), stage I (n= 23), stage II (n= 62) and stage III (n= 13). Use of CTEP to distinguish between tumors at stage 1 (N=23) and stage III (N=13) demonstrated an AUC = 0.7, significantly better than chance (p = 0.017). We also found that CTEP could distinguish between tumor without (N=49) and with (N=48) positive lymph nodes AUC = 0.59.

**CONCLUSION**

The results from this study indicate that quantitative MRI analysis shows promise as a means for predicting breast cancer stage and lymph node status.

**CLINICAL RELEVANCE/APPLICATION**

In an era of personalized treatment based on genetics, demonstrating that image based (MRI) phenotyping can contribute to prediction of cancer stage is important.

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**BRS269**

Clinical Validation of Combined X-ray and Optical Breast Imaging with 215 Lesion Cases (Station #6)

Qianqian Fang PhD, Bin Deng PhD (Presenter), Dana H. Brooks, Stefan Carp PhD, Richard H. Moore, Koninklijke Philips NV, A. ToBI Research support, General Electric Company Research support, Siemens AG Research support, Astrophysics Inc Research support, SAP AG, Daniel B. Kopans MD, General Electric Company Royalties, Cook Group Incorporated Consultant, Siemens AG, David Boas PhD, Koninklijke Philips NV Research Grant, Canon Inc

**PURPOSE**

Combining the structural information from x-ray mammography with the functional information from tomographic optical breast imaging (TOBI) represents a promising direction towards further enhancement of imaging sensitivity and specificity for clinical breast cancer diagnosis. Over the past 8 years, we have conducted a clinical study, including 307 subjects with breast lesions and 118 healthy volunteers, to validate the clinical efficacy of this new dual-modality approach.

**METHOD AND MATERIALS**

A total of 307 subjects with breast lesions were recruited between 2006 and 2013 under a HIPAA compliant protocol approved by the IRB. Among them, 215 subjects were found to have valid reconstructions and x-ray discernible lesions, including 99 malignant, 83 solid benign and 33 cystic lesions. All recruited subjects were scanned by a combined TOBI and tomosynthesis (DBT) system developed by our group. To utilize the spatially co-registered imaging information, we have developed a joint x-ray/TOBI reconstruction algorithm. Paired and two-sample t-tests are then used to find significant differences between different tissue types in the same breast as well as between lesion groups.

**RESULTS**

The reconstructed optical images with the structural-priors show more spatial details in the lesion region compared to those from the non-prior-guided reconstructions. One-tailed paired t-tests reveal significance differences in scattering coefficients (μs) at 830 nm between all pairs in adipose, fibroglandular tissues and lesions for all lesion groups. Significant difference in total hemoglobin concentration (HbT) between fibroglandular tissue and malignant tumors was also found (p=0.0009). Two sampled t-tests demonstrate significant differences in HbT (p=0.0139) and μs (p=0.0108) between malignant and solid benign lesions. The μs difference between solid benign and cystic lesions is nearly significant (p=0.0509).

**CONCLUSION**

The improved image quality achieved by fusing structural information in the optical reconstructions and the enhanced statistical power provided by a large study population has provided further evidence to support a combined x-ray/TOBI system as a clinically feasible approach for assisting breast cancer diagnosis.

**CLINICAL RELEVANCE/APPLICATION**

Combining optical imaging with x-ray mammography brings valuable functional assessment to the clinical evaluation of breast cancer, thus, leading to reduced unnecessary biopsies and missed cancers.

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**BRS270**

Evaluation of Image Quality and Diagnostic Performance of Breast Tomosynthesis at Reduced Exposure Dose (Station #7)

Arpad Bischof MD (Presenter), Thobias Muller, Joerg Barkhausen MD

**PURPOSE**

Combining the structural information from x-ray mammography with the functional information from tomographic optical breast imaging (TOBI) represents a promising direction towards further enhancement of imaging sensitivity and specificity for clinical breast cancer diagnosis. Over the past 8 years, we have conducted a clinical study, including 307 subjects with breast lesions and 118 healthy volunteers, to validate the clinical efficacy of this new dual-modality approach.

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A total of 307 subjects with breast lesions were recruited between 2006 and 2013 under a HIPAA compliant protocol approved by the IRB. Among them, 215 subjects were found to have valid reconstructions and x-ray discernible lesions, including 99 malignant, 83 solid benign and 33 cystic lesions. All recruited subjects were scanned by a combined TOBI and tomosynthesis (DBT) system developed by our group. To utilize the spatially co-registered imaging information, we have developed a joint x-ray/TOBI reconstruction algorithm. Paired and two-sample t-tests are then used to find significant differences between different tissue types in the same breast as well as between lesion groups.

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**CLINICAL RELEVANCE/APPLICATION**

Combining optical imaging with x-ray mammography brings valuable functional assessment to the clinical evaluation of breast cancer, thus, leading to reduced unnecessary biopsies and missed cancers.
PURPOSE

To analyse the impact of radiation dose, number of projections and projection angle on image quality and accuracy in digital breast tomosynthesis (DBT).

METHOD AND MATERIALS

57 DBT data sets (25 projections, angle 50°) with malignant and benign mass lesions were included into the study. Off-line image reconstruction was performed using all projections, every second (13 projections, angle 50°) and every third (9 projections, 50°) projection as well as 13 central projections (angle 25°) and 9 central projections only (angle 16°). The DBT images with a slice thickness of 1 mm were independently evaluated by five radiologists. The readers evaluated the subjective image quality and assigned each reconstruction to a BI-RADS category. Both, image quality and discriminatory power, were compared for benign and malignant lesions for each reconstruction.

RESULTS

Compared to the standard of reference (full number of projections) DBT images based on every second projection showed a comparable discriminatory power between benign and malignant lesions; positive-predictive value of 45.7% versus 44.3%, negative-predictive value 91.1% versus 92.7%. Despite good diagnostic performance, the subjective image quality of DBT image with reduced number of projections was rated lower compared to the reference. All other reconstructions using either 13 central projections with an angle of 25° or only 9 projections were inferior to the reference with regard to the diagnostic accuracy and the subjective image quality was rated lower compared to the approach using 13 projections with an angle of 50°.

CONCLUSION

For the detection and characterization of mass lesions DBT data sets using 13 projections with an angle of 50° can reduce the radiation exposure without decreasing the diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION

New reconstruction schemes can further reduce the radiation dose in digital breast tomosynthesis.

BRE117

Tomosynthesis Guided Needle Localization: An Instructional Guide with Examples (Station #8)

Nelly Salem MD (Presenter): Nothing to Disclose, Donna M. Plecha MD: Advisory Board, Hologic, Inc Research Grant, SuperSonic Imagine

TEACHING POINTS

To review indication, imaging appearance, and procedural methods of tomosynthesis-guided needle localization. The imaging and final pathology results from a series of 9 tomosynthesis-guided-needle localizations performed at our institution since the implementation of tomosynthesis in 2011 will be included.

TABLE OF CONTENTS/OUTLINE

- Introduction
- Indication
- How to do it: A Step-by-step guide
- Example with pictorial review of procedure
- Pathology
- Series of 8 additional cases demonstrating the findings on both 2D mammography and digital breast tomosynthesis and including the final pathology for each case
- Outcome
- Conclusion

BRE174

Breast Cancer In Women Under 40 Years: Frequency, Clinicopathologic and Imaging Features – 10 Years Of Experience (Station #9)

Tatiana Cardoso de Mello Tucunduva MD: Nothing to Disclose, Giselle Guedes Mello PhD (Presenter): Nothing to Disclose, Luciano F. Chala MD: Nothing to Disclose, Monica M.A. Stepcich MD, PhD: Nothing to Disclose, Joao Luiz Marin Casagrande MD: Nothing to Disclose, Andrea Maciel MD: Nothing to Disclose

PURPOSE

Breast cancer in young women are not common and it is widely believed that is characterized by a relatively unfavorable prognosis and pathological features. The aim of this study is to investigate frequency, clinicopathological and imaging features of breast cancer in women younger than 40 years in a specialised breast diagnostic center.

METHOD AND MATERIALS
Cases were retrospectively selected from our database of 8889 consecutive breast biopsies performed between February of 2003 and September 2013. There were 2284 (25.7%) patients under 40 years in this group. Frequency, clinicopathological and imaging features of breast cancer diagnosed in this group of women were determined.

RESULTS

Of 1820 malignant tumors, 212 were detected in women younger than 40 years, resulting in an overall frequency of 11.6% (212/1820) in this age group. The most common imaging presentation was irregular mass (54%), followed by mass with microcalcifications (19.7%). The most frequently histologic type was invasive ductal carcinoma (60.3%), manifesting as histological grade 1 (12%), grade 2 (46%) e grade 3 (42%), followed by in situ ductal carcinoma (28.7%). The immune profile showed 28% of HER2 overexpression cases and 23% of triple negative tumors.

CONCLUSION

In this study, the frequency of malignant breast lesions in patients under the age of 40 years was 11.6%, with a predominance of histological grade 2 and 3 ductal carcinomas and which manifests primarily as masses in imaging methods.

CLINICAL RELEVANCE/APPLICATION

The study of frequency and phenotypic features of the tumors in patients younger than 40 years generates epidemiological information and comparative basis of tumor behavior in different population groups.

BRE015-b The Uprooted Implant: A Multimodality Review of Breast Implant Rupture and Associated Complications (hardcopy backboard)

Nancy Anne Resteghini DO, MS (Presenter): Nothing to Disclose , Carolyn M. Debebenedictis MD : Nothing to Disclose , Glenn Allen Hoots MD : Nothing to Disclose

TEACHING POINTS

1. To review normal breast implant anatomy, including both implant location as well as different types of implants commonly encountered. 2. To discuss abnormal presentations of implant devices on mammography and MRI including classic signs of intracapsular and extracapsular rupture. 3. To highlight the importance of detecting implant complications, including post-operative peri-implant fluid collections, infection, and implant associated tumors. 4. To present various imaging modalities for evaluation of breast implant rupture with emphasis on which modalities are optimal.

TABLE OF CONTENTS/OUTLINE

1. Overview of normal breast implant anatomy. Prepectoral vs. Rectropectoral and their appearance on various imaging modalities. 2. Review types of breast implants and their normal imaging characteristics. Saline implant vs. Silicone implant and their appearance on various imaging modalities. 3. Discussion and examples of breast implant ruptures and their classic radiologic features. 4. Present examples of additional implant complications, including post-operative peri-implant fluid collections, infection, and implant associated tumors. 5. Provide examples of breast implant ruptures with Mammography/ MRI/Ultrasound while discussing the sensitivity/specificity of implant rupture detection for each modality.

CAS-TUB

Cardiac Tuesday Poster Discussions

Scientific Posters

CA

AMA PRA Category 1 Credits ™: .50

Tue, Dec 2 12:45 PM - 1:15 PM Location: CA Community, Learning Center

Sub-Events

CAS204 Finding the Optimal Dose Reduction and Iterative Reconstruction Level for Coronary Calcium Scoring: A Within Patients Analysis (Station #1)

Martin J. Willemink MD (Presenter): Nothing to Disclose , Adriana Maria den Harder BSC : Nothing to Disclose , Wouter Foppen MD : Nothing to Disclose , Hendrik M. Nathoe MD, PhD : Nothing to Disclose , Pim A. De Jong MD, PhD : Nothing to Disclose , Ricardo P.J. Budde MD, PhD : Nothing to Disclose , Tim Leiner MD, PhD : Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Bracco Group

PURPOSE

To find the maximally acceptable radiation dose reduction for accurate coronary calcium scoring (CCS).

METHOD AND MATERIALS
This prospective HIPAA compliant study was approved by our local institutional review board. Fifteen patients (9 men, mean age 56.8±6.8 years) underwent 4 calcium scoring computed tomography (CT) scans in a single session. Image acquisition was performed with a 256-slice CT system (iCT, Philips Healthcare) at routine, 40%-reduced, 60%-reduced and 80%-reduced doses. A fixed tube voltage of 120 kVp was applied and radiation dose was reduced by lowering tube current. Raw data were reconstructed with standard filtered back projection (FBP) and iterative reconstruction (IR, iDose4 levels 1, 4 and 7). Agatston scores were assessed with commercially available validated software (Heartbeat CS).

RESULTS

Effective dose values were 0.85±0.07, 0.51±0.04, 0.33±0.05, and 0.17±0.01 mSv, respectively. Routine dose acquisitions with FBP resulted in Agatston scores of 0 (N=3), 1-10 (N =4), 11-100 (N =5), 101-400 (N =2), and >400 (N =1). At 40%-reduced dose FBP acquisitions, 2 subjects (13.3%) were reclassified into higher categories with FBP and IR. 1 subject (6.7%) had false negative scores with IR levels 4 and 7. At 60%-reduced dose FBP acquisitions, 3 subjects (20%) were reclassified into higher risk categories and 1 subject (6.7%) had a false negative score. At this dose level, IR resulted in only 1 reclassification (6.7%) to a higher category and 3 reclassifications (20%) to lower categories, under which 2 false negatives. At 80%-reduced dose FBP acquisitions, 3 scans (20%) were not interpretable due to overwhelming noise artifacts and 6 scans (40%) were incorrectly reclassified. With IR, all scans were interpretable. IR levels 4 and 7 resulted in less reclassifications, 3 subjects (20%) were reclassified into lower categories including 2 false negatives (13.3%).

CONCLUSION

This within-patients analysis showed that 80%-reduced dose FBP resulted in non-interpretable scans or reclassifications in 60% of subjects, which decreased with IR to 20%. Therefore, CCS may be done at 0.17 mSv with medium to high IR levels. However, results should be validated in a larger population.

CLINICAL RELEVANCE/APPLICATION

Coronary calcium scoring at a radiation dose as low as 0.17 mSv may be possible with medium to high iterative reconstruction levels.

CAS206

Correlation of Cardiac MRI Derived MAPSE, TAPSE, Ventricular Function and T2 Star in Children with Iron Overload (Station #3)

Deepa Prasad MBBS, MD (Presenter): Nothing to Disclose, Anna Marie West BS: Nothing to Disclose, Apurva Bansal MBBS: Nothing to Disclose, Ravi Ashwath MD: Nothing to Disclose

PURPOSE

It has been well established that cardiac MRI (CMR) T2 Star (*) is a useful technique to evaluate myocardial iron concentration by the use of gradient echo. T2* has been shown to correlate well with left ventricular ejection fraction (LVEF) in these patients. Functional quantification of ventricles is time consuming. Echo derived mitral and tricuspid annular plane systolic excursion (MAPSE and TAPSE) are quick and easily reproducible parameters, which have been shown to be good surrogates of LV and RV function in adult patients. CMR derived MAPSE and TAPSE have not been studied sufficiently in the pediatric population. The purpose of this study is to demonstrate correlation between MAPSE, TAPSE, ventricular function and T2 * in children with myocardial iron overload.

METHOD AND MATERIALS

A retrospective study of 37 patients with transfusion dependent anemia was performed. LVEF and RVEF were obtained from short axis cine images utilizing 1.5 T CMR scanner. T2* was obtained by the use of single breath hold, multiecho acquisition with a constant TR. MAPSE and TAPSE were derived from cine images obtained from ventricular long axis views. All the above parameters were analyzed to assess correlation using Spearman’s correlation, r >0.3 and P < 0.05 were considered significant.

RESULTS

A linear moderate positive correlation was noted between LVEF and MAPSE (r=0.42, P< 0.05). T2* showed linear positive correlation with LVEF (r=0.34, P<0.05) but no correlation with MAPSE. However, in the group with T2* <35 msec, there was a linear positive correlation noted between T2 star and MAPSE (R=0.34, P<0.05). There was no correlation between T2*, RVF and TAPSE.

CONCLUSION

MAPSE correlates with T2*< 35 msec and LVEF, and it could prove to be a sufficient surrogate for LV function assessment and potentially replace the time consuming LVEF assessment by CMR in a selective group of children with iron overload.

CLINICAL RELEVANCE/APPLICATION

MAPSE correlates well with LVEF and can potentially replace the time consuming LVEF estimation by CMR in patients with iron overload.

CAS207

The Role of Various Imaging Modalities in the Placement of AICDs in Patients with Low LVEF (Station #4)

Raj Pulin Shah MD, MBA (Presenter): Nothing to Disclose, Electra Vesin Kaloudis MD, MPH: Nothing to Disclose, Christopher Pickett MD: Nothing to Disclose
PURPOSE
In the setting of discordant LVEF data, a growing use of Cardiac MRI (CMR), and a lack of randomized control trial data using MRI to assess LVEF prior to ICD implants, we wish to assess patterns of clinical use of CMR and risk assessment before ICD placement.

METHOD AND MATERIALS
This study contained a survey, which addressed clinical guidelines and standard of care practices; American board-certified cardiologists in our geographic area participated in the voluntary study, which took approximately 10 minutes to complete.

RESULTS
33 cardiologists participated in the survey; when given a clinical scenario of a hypertensive patient with ischemic cardiomyopathy, NYHA class II symptoms and disparate LVEF readings: 30% on echocardiogram, 35% on myocardial perfusion, and 45% on cardiac MRI, in other words, meeting criteria for ICD by echocardiogram and myocardial perfusion but not CMR, there was no consensus on appropriateness of ICD implant amongst our surveyed cardiologists. 42% stated that they would recommend ICD placement, and equal number said that they would not recommend an ICD. 15% would refer the patient to an electrophysiologist for further evaluation. When given the same scenario, but a non-ischemic cardiomyopathy, and disparate LVEF readings, our surveyed cardiologists became less likely to refer for ICD. 30% of cardiologists stated that they would recommend ICD placement, whereas 46% said that they would not. 15% would refer the patient to an electrophysiologist for evaluation, and 9% would further stratify risk.

CONCLUSION
In this group of surveyed cardiologists, although 97% most frequently used echocardiogram in their practices to assess LVEF (in patients with ischemic and non-ischemic cardiomyopathy), less than half chose to give weightage to its result when discrepant nuclear stress test and CMR results were available. Although there is no randomized control trial to support the use of MRI in assessing LVEF prior to the placement of ICD implants, clinicians are sometimes relying on its results. With a lack of consensus amongst practitioners on how to manage discrepant LVEF data, there is a potential for variable implementation of guideline-supported treatment with primary prevention ICDs.

CLINICAL RELEVANCE/APPLICATION
Baring consensus statement from governing societies on how to extrapolate CMR derived LVEF to vulnerable populations, we expect that this will continue to be an area of clinical uncertainty.

CAS208
Noncompaction Cardiomyopathy: Left Ventricular Systolic Dysfunction is not Correlated to Non-compacted Myocardial Extent on Cardiac Magnetic Resonance (Station #5)

Nicola Galea MD : Nothing to Disclose, Marco Francone MD : Speakers Bureau, Bracco nv, Valentina Sorrentino : Nothing to Disclose, Vincenzo Noce MD : Nothing to Disclose, Giovanni Barchetti : Nothing to Disclose, Giuseppe Cannavale MD : Nothing to Disclose, Iacopo Carbone MD (Presenter) : Nothing to Disclose, Carlo Catalano MD : Nothing to Disclose

PURPOSE
Non-compaction cardiomyopathy (NCC) is characterized by uncompleted myocardial compaction. Our purpose was to correlate the morphological features of NCC with the impairment of left ventricular (LV) contractile function using Cardiac Magnetic Resonance (CMR).

METHOD AND MATERIALS
Fifteen patients with echocardiography diagnosis of NCC performed a CMR study using a 1.5T MR unit, cineMR b-SSFP and late enhancement (LE) sequences after Gadobenate dimeglumine administration. Compact myocardial mass (CMM), non-compact myocardial mass (NCMM), non-compact to compact myocardial mass ratio (NC/C mass ratio), non-compact to compact myocardial thickness ratio (NC/C ratio), number of affected LV segments (nNC) were analysed and correlated to left ventricular volumes, ejection fraction (EF), peak filling rate (PFR) and peak ejection rate (PER). Pearson correlation test was performed.

RESULTS
The mean values of NC/C mass ratio, NC/C ratio and number of affected segments were respectively 0.4, 2.6 and 9.9. No significant correlations were found between NC/C mass ratio both PER (p: 0.10), FE (p: 0.15) and PFR (p: 0.25), and between nNC and PER (p: 0.14). NC/C ratio showed no significant correlation with PER (p: 0.21), FE (p:0.54) and PFR (p: 0.17).

CONCLUSION
In NCC contractile dysfunction entity, expressed by reduction of PER and EF, is not directly related to the increase of NC/C ratio or with changes in NC/C mass ratio. Further index of structural abnormality should be considered to characterize disease severity.

CLINICAL RELEVANCE/APPLICATION
The current diagnostic criteria for "non-compaction cardiomyopathy" determine an overdiagnosis of this still poorly understood disease with an increasing alarm in subjects with one of the non-pathological anatomical variants. According to our results the increase of structural morphological alteration does not cause "per se" higher degree of functional impairment, therefore the diagnostic criteria should be further discussed.

CAS209
Quantification of Coronary Artery Stenosis with 320-Row CT Angiography in a Moving Heart Phantom: Comparison with Quantitative Coronary Angiography (Station #6)

Petra Kozma (Presenter) : Nothing to Disclose, Marc Dewey MD : Research Grant, General Electric
Company Research Grant, Bracco Group Research Grant, Guerbet SA Research Grant, Toshiba Corporation Speakers Bureau, Toshiba Corporation Speakers Bureau, Guerbet SA Speakers Bureau, Bayer AG Consultant, Guerbet SA Author, Springer Science+Business Media Deutschland GmbH Editor, Springer Science+Business Media Deutschland GmbH Institutional research agreement, Siemens AG Institutional research agreement, Koninklijke Philips NV Institutional research agreement, Toshiba Corporation

**PURPOSE**

Accuracy of computed tomography angiography (CTA) for coronary stenosis quantification has been reported to be poor when compared with the reference gold standard quantitative coronary angiography (QCA).

**METHOD AND MATERIALS**

A moving heart phantom with non-calcified coronary stenoses of different size (25, 50, and 75%) as well as different shapes (D-shaped, concentric, and eccentric) were imaged using 320-row CTA. Image acquisition parameters were: 80, 10, and 120 kVp with tube currents of 100, 250, and 500 mA. Reconstructions included both iterative reconstruction (IR) and standard FBP. The same vessels were examined using QCA (without simulated heart motion) in the projection showing the worst view of all stenoses as the reference standard.

**RESULTS**

CTA at 120 kVp, 100 kVp, 80 kVp and 500 mA, 250 mA and 100 mA showed very good agreement and correlation with QCA for coronary stenosis quantification. Tube current modulation did not have an overall significant effect on stenosis quantification with both reconstructions at all tube voltage levels (p>0.05, ANOVA). No significant difference was found between the limits of agreement comparing results with 120 kVp, 100 kVp and 80 kVp (p=0.05, F-test). Also no significant difference was found comparing the limits of agreement between IR and FBP with 120 kVp and 100 kVp (p=0.05 for both), with 80 kVp slightly narrower limits of agreement were shown with IR than with FBP (p=0.04). Through all stenoses no significant over- or underestimation was shown comparing manual stenosis quantification in CTA and QCA with both IR and FBP at 120 kVp, 100 kVp and 80 kVp (p>0.05 for all, t-test).

**CONCLUSION**

In a moving heart phantom, 320-row CTA had very good agreement with QCA for stenosis quantification. Additionally using IR with adjusted scan parameters can further reduce effective radiation dose and may even improve diagnostic accuracy.

**CLINICAL RELEVANCE/APPLICATION**

These results indicate a potential clinical use of most recent generation CT scanners also for quantification of coronary stenosis and implicate the use of IR with adjusted scan parameters.

**CAE124**

**“Bands, Chords, Tendons and Membranes in the Heart” (Station #7)**

Ameya Jagadish Baxi MBBS, DMRD (Presenter) : Nothing to Disclose, Carlos S. Restrepo MD : Nothing to Disclose, Daniel Vargas MD : Nothing to Disclose, Daniel Ocaizonez MD : Nothing to Disclose, Horacio Murillo MD, PhD : Nothing to Disclose, Rashmi S. Katre : Nothing to Disclose, Sina Tavakoli MD : Nothing to Disclose, Cylin Javidan Nejad MD : Nothing to Disclose

**TEACHING POINTS**

1. Study accessory bands within cardiac chambers and differentiate them from normal muscular bands, accessory chordae tendineaea and papillary muscles 2. Discuss pathological bands and membranes affecting heart 3. Illustrate imaging appearance of these conditions on MDCT and MRI

**TABLE OF CONTENTS/OUTLINE**

The number, size and morphology of chordae tendineae and papillary muscles is variable. Accessory bands may be asymptomatic incidental findings or can be associated with congenital heart diseases. Their radiological appearances is similar to that of normal muscular bands. However at times they may be pathological and can cause with hemodynamic alterations with adverse clinical implications. They can restrict mobility and cause outlet obstruction. Ruptured accessory chordae tendineae can cause regurgitation. Echocardiography, CT scan and MRI can be used for evaluation of accessory bands. Radiologists should know the advantages and limitations of each imaging modality. They should be familiar with the imaging appearances of these bands and understand their clinical significance. In this educational exhibit, we discuss • Introduction • Anatomy and anatomic variants • Accessory bands, chords, tendons and membranes in the Heart • Pathological conditions • Cross-sectional imaging findings and role of imaging • Clinical implications • Conclusion

**CAE133**

**Heart and Lungs in Pulmonary Hypertension: What Cardio-Thoracic Magnetic Resonance Imaging Can Offer for Patient Management (Station #8)**

Monda Lotfy Shehata MD (Presenter): Nothing to Disclose, Christian Olaf Schoenfeld MD : Nothing to Disclose, Jan Hinrichs MD : Nothing to Disclose, Julius Kenne MD : Nothing to Disclose, Oleg Teytelboym MD : Nothing to Disclose, Frank K. Wacker MD : Research Grant, Siemens AG Research Grant, Pro Medicus Limited, Marius Hoeper : Nothing to Disclose, Jens Vogel-Claussen MD : Nothing to Disclose

**TEACHING POINTS**

Understand the pathophysiology of pulmonary hypertension (PH) and its effect on right ventricular (RV) remodeling and interventricular dependence. Familiarize the reader with the cardiopulmonary imaging findings in PH patients. Understand the current role of cardiothoracic magnetic resonance (CMR) in evaluation of the cardiopulmonary unit in PH. Identify novel diagnostic and prognostic markers provided by CMR for PH.
TABLE OF CONTENTS/OUTLINE

1. Definitions.
2. Updated classification of pulmonary hypertension
3. Pathophysiology focusing on pulmonary vascular remodeling, RV adaptive mechanisms and interventricular dependence in the setting of RV overload and its effect on clinical course.
4. Diagnostic workup of pulmonary hypertension.
5. Practical considerations for CMR in PH patients including indications and protocol tailoring.
6. Illustration of imaging findings of PH on CMR including:
   • Biventricular global and regional function changes.
   • Assessment of RV remodeling, scarring and perfusion alterations.
   • Assessment of interventricular dependence.
   • Pulmonary vascular remodeling and flow alterations.
   • Pulmonary perfusion changes in different types of pulmonary hypertension.
7. CMR imaging markers and their prognostic value in patient management and monitoring.

CHS-TUB

Chest Tuesday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits™ .50

Tue, Dec 2 12:45 PM - 1:15 PM Location: CH Community, Learning Center

Sub-Events

CHS257

**Idiopathic Pulmonary Fibrosis (IPF)/Usual Interstitial Pneumonia (UIP) without Honeycombing on CT: CT findings in 30 Patients Diagnosed by Surgical Lung Biopsy (Station #1)**


**PURPOSE**

In the ATS-ERS-JRS-ALAT 2011 IPF/UIP guideline, CT diagnostic criteria do not include CT findings corresponding to the two pathological hallmarks; lobular heterogeneity and perilobular predominance. The aims of the study were to describe CT findings of IPF/UIP without honeycombing and to clarify CT findings corresponding to lobular heterogeneity and perilobular predominance.

**METHOD AND MATERIALS**

The study included 30 patients with IPF/UIP who had the multidisciplinary diagnosis and did not show honeycombing on CT. The patients ranged from 55 to 70 years of age (mean 64.3), and included 22 males and eight females. Two observers independently evaluated the existences, distributions, and extents of ground-glass attenuation, airspace consolidation, reticular shadow, nodules, and traction bronchiectasis on CT. The extent of each finding was graded as following 4-points scales; 0: no involvement, 1: less than 10% involvement of total lung, 2: 10-30% involvement, and 3: more than or equal to 30%. Moreover, the existences of lobular heterogeneity and perilobular opacity were also evaluated. Lobular heterogeneity was defined as the existence of lobules which had more than four findings including normal appearance. Perilobular opacity was determined as either irregular pleural surface, irregular thickening of bronchovascular bundles, or irregular thickened interlobular septa. Furthermore, each case was incorporated into three categories (UIP, possible UIP, and inconsistent with UIP) in CT diagnostic criteria of ATS-ERS-JRS-ALAT guideline.

**RESULTS**

Lobular heterogeneity, perilobular opacity, reticular shadow, ground-glass attenuation, and traction bronchiectasis were seen in all 30 patients. Lower lobe predominance and peripheral predominance were found in 28(93%) and 27 patients(90%), respectively. In 29 patients (97%), the extent of areas with ground-glass attenuation (Mean score; 2.2) was larger than that of reticular shadow (Mean score; 1.1)(paired t-test; p<0.01). These 29 cases were categorized into the inconsistent with UIP pattern on CT.

**CONCLUSION**

Perilobular opacity and lobular heterogeneity on CT are seen in all patients with IPF/UIP. Detection of both findings is feasible for the diagnosis of IPF/UIP.
Inhalation Lung Injury by Hydrogen Chloride: Radiologic Spectrum with Serial Follow-up Study (Station #2)

Ji Yung Choo MD : Nothing to Disclose , Ki Yeol Lee MD, PhD : Nothing to Disclose , JungWon Kwak (Presenter) : Nothing to Disclose , Sung-Joon Park MD : Nothing to Disclose , Je Hyeong Kim : Nothing to Disclose , Eun-Young Kang MD : Nothing to Disclose , Whan Oh : Nothing to Disclose

PURPOSE

Hydrogen chloride (HCL) is a colorless, irritating and corrosive gas and vary widely used in the industry. Because of its strong acidity, it is easy for people to misunderstand that HCL inhalation is always significantly fatal. Despite of its general use, no imaging features after inhalation exposure have been previously described. In the present study, we analyzed high-resolution computed tomography findings of HCL inhaled lung injury and reviewed its pathophysiology through literature review.

METHOD AND MATERIALS

Seven patients (24 to 65 years, mean age, 41.9 years) inhaled HCL vapor on their occupational working process dealing with HCL. We retrospectively reviewed clinical symptoms, initial blood gas analysis and pulmonary function test as well as serial HRCT findings.

RESULTS

HCL inhaled lung injury showed 3 patterns of HRCT findings; bilateral symmetric consolidation and GGO with interstitial thickening in central portion suggesting permeability pulmonary edema, irregular linear abnormalities or centrilobular nodules in both lower lungs. These abnormalities tended to grossly improve within one week after exposure. Centrilobular nodules with air trapping indicating bronchiolitis and bronchiectasis may remain as sequelae on follow up study after 3-6 months.

CONCLUSION

Airspace consolidation, followed by ground glass attenuation, interlobular septal thickening and centrilobular nodules were common on the initial CT scans. Serial follow-up CT scans included bronchiolitis obliterans, bronchiectasis and mosaics attenuation. It is meaningful that this study demonstrates the serial change in lung observed by CT after inhalation injury by HCL single gas.

CHS259

Metastases in Mediastinal and Hilar Lymph Nodes in Patients with Lung Carcinoma : Quantitative Assessments with DW- and STIR- MR Imaging—What is the Appropriate Method for Detection of Metastases in Lymph Nodes on the DW- and STIR- MR Images? (Station #3)

Jun Nakayama MD (Presenter): Nothing to Disclose , Kazuo Miyasaka MD, PhD : Nothing to Disclose

PURPOSE

To evaluate DW- and STIR- MR imaging for detection of metastases in lymph nodes by using quantitative analyses.

METHOD AND MATERIALS

78 patients with lung cancer who ranged in age from 46 to 84 were examined with DW- and STIR- MR imaging. Ratios of signal intensity in lung cancer and lymph node to that in spinal cord(LcScR1s and LnScR1s) and to that in 0.9% saline phantom (LcSR1s and LnSR1s) were calculated from DW MR images with high b values. ADCs in each lung cancer and lymph node were calculated from DW MR images obtained with low and high b values. The difference of LcScR1s and LnScR1s(D1), that of LcSR1s and LnSR1s(D2), and that of the ADC in lung cancer and lymph node(D3) were calculated. Ratios of signal intensity in lung cancer and lymph node to that in spinal cord(LcScR2s and LnScR2s) and to that in 0.9% saline phantom (LcSR2s and LnSR2s) were calculated from STIR MR images. The difference of LcScR2s and LnScR2s(D4), that of LcSR2s and LnSR2s(D5) were calculated. For quantitative analysis, the threshold value for positive test was determined on a per-node basis and tested for ability to enable a correct diagnosis on a per-patient basis. Results of quantitative analyses were compared on a per-patient basis with McNemar testing.

RESULTS

Mean LnScR1, LnSR1, LnScR2, ADC in lymph node, D1, D2, D3, and D5 in the lymph node group with metastasis was significantly different from those in the lymph node group without metastasis(P<.05). When LnScR1 of 0.629, LnSR1 of 0.774, LnScR2 of 0.320, ADC of 1.681×10-3mm2/sec., D1 of 0.598, D2 of 0.761, D3 of 0.296×10-3mm2/sec., and D5 of 0.104 were used as the positive-test threshold, sensitivities were 87.5%, 87.5%, 93.8%, 81.3%, 86.8%, 87.5%, 93.8%, and 87.5%, respectively. Specificities were 83.9%, 87.1%, 87.5%, 87.5%, 81.3%, 86.8%, 87.5%, 93.8%, and 87.5%, respectively.
Quantitative analyses of DW- and STIR- MR images on a per patient basis, the sensitivity, specificity of D3 were greater than or equal to those of LnScR1, LnSR1, LnSR2, ADC, D1, D2, and D5.

CONCLUSION

Quantitative analyses by using LnScR1s, LnSR1s, LnSR2s, ADC, D1s, D2s, D3s, and D5s enable characterization of lymph nodes. D3s measurement may be especially useful.

CLINICAL RELEVANCE/APPLICATION

The difference of the ADC value in a lung cancer and a lymph node measurement may be especially useful for differentiating between lymph nodes with metastasis and those without metastasis.

Patients with Emphysema: What is the Actual Risk of Pneumothorax-related Complications for these Patients during Percutaneous Lung Biopsies? (Station #4)


PURPOSE

Although it is a commonly held belief that patients with emphysema are at increased risk for pneumothorax-related complications during lung biopsy, there is a paucity of data on the subject to determine if this is actually true, and if so, the magnitude of the increase in risk. This can make it difficult to accurately assess the risk vs the benefit of performing these procedures in patients with significant emphysema. The purpose of this study was to determine whether there is an association between emphysema and the number and severity of pneumothorax-related complications encountered during CT-guided percutaneous lung biopsies.

METHOD AND MATERIALS

We reviewed all CT-guided lung biopsies performed between August 2006 and September 2013. Patients were excluded if no aerated lung was crossed. All other patients were included. Data collected included: number of pneumothoraces, number of pneumothoraces requiring an intervention (e.g. temporary catheter placement for aspiration or pleural blood patch placement), and number of pneumothoraces requiring chest tube placement and hospital admission. Presence of underlying emphysema along the biopsy path was recorded as none, mild, moderate or severe.

RESULTS

835 total patients were included in the study. The pneumothorax rate, rate of pneumothoraces requiring an intervention, and rate of pneumothoraces requiring chest tube placement and hospital admission were significantly higher in patients with moderate to severe emphysema as compared to those with none to mild emphysema ((86/194) 44.3% vs (212/641) 33.1%, p=0.005; (50/194) 25.8% vs (78/641) 12.2%, p=0.0001; and (19/194) 9.8% vs (20/641) 3.1%, p=0.0003, respectively)).

CONCLUSION

Moderate to severe emphysema is associated with a significantly increased rate of pneumothorax-related complications during percutaneous lung biopsies. More specifically, moderate to severe emphysema is associated with a ~2.5 times higher rate of pneumothorax-related complication requiring intervention and an ~3 times higher rate of chest tube placement and hospital admission. Understanding the magnitude of these risks will allow improved decision making and informed consent for these patients.

CLINICAL RELEVANCE/APPLICATION

This study provides an objective measure of the increased risk of lung biopsy in patients with emphysema, and thus promotes improved decision making and informed consent for these patients.
PURPOSE

Acute adrenal ischemia represents a rare clinical event which should be promptly diagnosed in order to preserve the adrenal vitality and function. This study aims to evaluate the diagnostic accuracy of a new CT sign in order to define or exclude an initial phase of adrenal ischemia.

METHOD AND MATERIALS

69 patients suspected of having adrenal ischemia underwent 320-row CT examination. CT multi-planar images were evaluated searching for the patency of adrenal arterial and venous vessels, adrenal gland volume and the presence of the "capsular sign" represented by the evidence of a peripheral subtle hyper-dense line around an hypo-dense enlarged adrenal gland. All CT findings were then compared with the surgical findings (n=5), follow-up examinations (n=20) or autopsy (n=4). Sensitivity, specificity, diagnostic accuracy (DA), positive predictive value (PPV) and negative (NPV) were calculated for the "capsular sign" and represented by ROC analysis.

RESULTS

Acute adrenal ischemia occurred in 29/69 patients (42%), unilateral in 20 and bilateral in 9. Venous thrombosis was found in 20/29 (69%) and arterial hypo-perfusion in 9/29 (31%). The sign was found in 24/29 patients (83%). Sensitivity, specificity, DA, PPV and NPV values of 83%, 100%, 93%, 100% and 89%, respectively, were obtained.

CONCLUSION

The "capsular sign" represents a CT finding to be searched when an acute adrenal pathological condition is suspected. Its evidence correlates to acute ischemia with a 100% probability and when it is not found, the probability of a non-ischemic condition is 89%.

CLINICAL RELEVANCE/APPLICATION

The proposed CT "capsular sign" could represent a specific finding of acute adrenal ischemia providing a prompt diagnosis in the early phase of the disease.

ERS224

Frequency of IV Contrast CT Findings and Most Frequent Sites of Involvement in Pathologically Proven Cases of Ischemic Colitis (Station #2)

Cinthia Cruz MD (Presenter): Nothing to Disclose, Hani H. Abujudeh MD, MBA: Research Grant, Bracco Group Consultant, RCG HealthCare Consulting Author, Oxford University Press, Rosalynn Nazarian MD: Nothing to Disclose, James H. Thrall MD: Board Member, Mobile Aspects, Inc Board Member, WorldCare International, Inc

PURPOSE

Determine the most frequent findings on IV contrast CT examinations of pathologically proven cases of ischemic colitis and define the most frequent sites of colonic involvement.

METHOD AND MATERIALS

IRB compliant retrospective review of CT examinations done with intravenous contrast of pathologically proven cases of ischemic colitis, from 2007 to 2010 in our institution. Patients with a history of recent abdominal surgery or trauma, and those without a concurrent IV contrast enhanced CT at time of diagnosis were excluded. 102 scans were analyzed for the presence of the following criteria involving the colon: abnormal wall enhancement, bowel wall thickening, dilatation, mesenteric fat stranding, venous engorgement, presence of fluid or ascites, pneumatosis-portomesenteric gas, infarcts of other organs and vasculature occlusion. Affected segments of the colon were noted.

RESULTS

Colonic wall thickening and mesenteric fat stranding were the most frequently seen findings, each was present in 90 of 102 cases (88%). Altered wall enhancement was detected in 84 of 102 cases (82%), increased enhancement was the most common pattern. Venous engorgement, was seen in 52 of 102 patients(51%). 36 of 102 cases (35%) in our series showed pericolonic fluid or ascites, in 27 of 36 cases (75%) fluid was present in small or trace amounts. Only 20 of 102 (20%) patients were found to have colonic dilatation. Pneumatosis was observed in 10 of 102 (9.8%) exams, with the presence of portomesenteric gas in 2 of those 10 cases (20%). Mesenteric arterial occlusion was observed in only 1 case of 102 (0.9%). No Infarcts of other organs were observed. Segmental distribution of ischemia was described in 96/102 (92%) cases whereas the involvement of the entire colon was seen only in 6/102 (5.9%) of the scans. Descending colon and sigmoid were the most frequently involved segments at 64 of 102 (62.7%) and 58 of 102 (56.9%) cases, and with fewer cases: transverse 23 of 102 (22.5%) and caecum 21 of 102 (21%).

CONCLUSION

The most frequent IV contrast CT findings in patients diagnosed with ischemic colitis are: Bowel wall thickening, fat stranding, abnormal wall enhancement and venous engorgement. The descending and sigmoid colon are the most frequently involved segments in ischemic colitis, and with lower incidences transverse and caecum.

CLINICAL RELEVANCE/APPLICATION

IV contrast CT is critical to demonstrate the findings in the early onset of ischemic colitis and its possible causes.
Adults with Acute Appendicitis: Comparison between Computed Tomography, Histopathological Findings and C-reactive Protein (CRP) in patients with acute appendicitis (AA).

**METHOD AND MATERIALS**

76 consecutive patients (age 56±17.9y; range 23-97y) were categorized into one of three groups (GR) based on the histopathologic evaluation: ulcer-phaegmonous AA (GR1), gangrenous AA (GR2), and perforation (GR3). All patients underwent preoperative contrast-enhanced low-dose CT. Two blinded readers reviewed images in consensus and patients were assigned into one of three GR using following criteria: Patients in GR1/GR2 showed wall thickness (2-3mm/>3mm) with ring-like contrast enhancement, a cross-sectional diameter (6-10mm/>10mm), and moderate/high grade of peripendicular fat attenuation, respectively, and patients in GR3 showed an abscess formation in the RLQ. CRP levels were correlated using p-values from Mann-Whitney's U test and receiver operating characteristic (ROC) curve analysis was performed for identification of cutoff-point for perforation.

**RESULTS**

According to histopathological evaluation, 49/76 patients (64.5%) were assigned into GR1, 5/76 patients (6.6%) into GR2, and 22/76 patients (28.9%) into GR3. Using MDC, 42/49 patients (85.7%) were correctly identified as GR1, however, 7/49 patients (14.3%) were falsely classified as GR2. 2/5 patients (40%) were correctly identified as GR2, and 3/5 patients (60%) were falsely classified as GR1. 19/22 patients (86.4%) were correctly identified as GR3, and 3/22 patients (13.6%) were falsely classified as GR2. Mean CRP was 56mg/l ± 99 (range 0-359mg/l) in GR1, 117mg/l ± 64 (range 32-208mg/l) in GR2, and 139mg/l ± 84 (range 59-353mg/l) in GR3. CRP was significantly different between GR1 and GR2 (p<0.01). ROC analysis revealed an optimal cut-off point of >72mg/l for identification of perforation (AUC=0.725), resulting in a sensitivity of 86.4% and a specificity of 55.1%. CRP was neither significantly different between GR1 and GR2 (p=0.206) nor between GR2 and GR3 (p=0.786).

**CONCLUSION**

In patients with suspected AA and highly elevated CRP levels, CT is able to rule out perforation.

CT may help to predict the relevant differences in histopathological grading. The differentiation between patients in GR1 and GR3 could lead to a different surgical approach (open vs. laparoscopic).
CONCLUSION
Automated curved reconstruction CT maps of ribs can shorten interpretation time needed for the detection of rib fractures with similar diagnostic performance of axial CT image interpretation.

CLINICAL RELEVANCE/APPLICATION
Automated curved reconstruction CT maps of the ribs can shorten interpretation time needed for the detection of rib fracture and can increase efficiency of trauma CT interpretation.

ERE167
MDCT of High Energy Pelvic Ring Disruptions in Blunt Trauma (Station #3)
David Dreizin MD (Presenter): Nothing to Disclose, Haoxing Chen BS: Nothing to Disclose, Felipe Munera MD: Nothing to Disclose, Krystal Archer-Arroyo MD: Nothing to Disclose, Daniel Christopher Mascarenhas BS: Nothing to Disclose, Deborah Stein MD, PhD: Nothing to Disclose, Thomas M. Scalea MD: Nothing to Disclose, Uttam Bodanapally MD: Nothing to Disclose

TEACHING POINTS
After completing this exhibit, viewers will be able to... Describe the basic patterns of injury of the Young-Burgess and Tile classification systems of pelvic ring disruption. Explain the anatomic and mechanistic basis of traumatic pelvic ring instability. Describe management of instability and associated vascular and soft tissue injuries

TABLE OF CONTENTS/OUTLINE
1. Introduction Blunt pelvic trauma epidemiology Anatomy and biomechanics Posterior sacroiliac ligament complex and sagittal stabilizers Anterior pelvic ring: pubic symphysis and rami Vector forces, internal and external rotation/torque 2. Classification systems of pelvic ring disruption Defining instability Young-Burgess classification Tile classification Strengths and limitations of each system 3. Management of bony and ligamentous instability in the acute setting. Pelvic binders Angloembolization External fixation and percutaneous screw placement 4. Associated soft tissue injuries Pelvic extraperitoneal hematomas (arterial, venous, and bony bleeds) Open and occult contaminated injuries Genitourinary trauma Rectus sheath avulsion Degloving injuries (e.g. Morell-lavallee) 5. Conclusion

ERE160
What's New in Thoracolumbar Spine Trauma? The Latest Thoracolumbar Injury Classification and Severity Score (TLICS) and MRI as the Game-Changer (Station #6)
Jiamin Juliana Zheng MD (Presenter): Nothing to Disclose, Nima Razaghi Kashani MD: Nothing to Disclose

TEACHING POINTS
1) To present the new thoracolumbar injury classification and severity score (TLICS) as the increasingly adopted classification system by spine surgeons. 2) To understand the differences and advantages of TLICS compared to traditional classification systems such as the 3-columns of Denis by offering prognostic information and aiding in management decisions. 3) To recognize the importance of the posterior ligamentous complex as the most important component in stability of the spine in this new paradigm and the role of MRI. 4) To learn how to accurately score and report each component of TLICS. 5) To recognize common imaging pitfalls in the evaluation of spine trauma.

TABLE OF CONTENTS/OUTLINE
1) Mechanisms of spinal trauma and patterns of injuries 2) What is TLICS and why is it eclipsing other classification systems? 3) Illustration through cases of how to score TLICS based on its 3 components a. Morphology of the fracture b. Integrity of the posterior ligamentous complex c. Neurological status assessed clinically 4) How good are we at evaluating each component? a. Review of 12 cases shown to 3 independent MSK radiologists and 3 independent spine surgeons, inter-observer reliability will be presented along with data from literature review. b. Pitfalls leading to error in scoring will be depicted through cases.
PURPOSE

MR images present significant intensity variation across patients and scanners irrespective of imaging sequence used. The presence of thermal noise, image inhomogeneity and non-standarndness of the MR image intensity gray scale poses challenges to MR image analysis. The purpose of this study is to demonstrate how a pattern classification strategy may be effective in liver MRI once the images are first "cleaned" as optimally as possible by correcting for intensity inhomogeneity and by accounting for non-standardness, so that image intensities are made to have consistent tissue specific meanings.

METHOD AND MATERIALS

20 normal subjects and 30 cirrhosis patients who underwent T1-weighted (T1W) and T2-weighted (T2W) MRI of the abdomen were retrospectively studied. Image correction was performed for radiofrequency field inhomogeneities, and the live wire method was used to segment the liver and generate a liver mask. The liver mask was overlaid upon the corrected image and the resultant image was standardized for intensity. The standardized MRI intensity statistics were calculated within the liver mask.

RESULTS

The cumulative histogram for each imaging sequence for each group appeared chaotic before standardization but well-behaved after standardization. Mean intensity, standard deviation, and %coefficient of variation from these distributions without vs. with standardization, respectively, were as follows. Normal: In-phase T1W (301, 219, 73% vs. 2707, 479, 18%); Opposed-phase T1W (270, 190, 70% vs. 2665, 700, 26%); Fat-suppressed opposed-phase 3D T1W (297, 266, 90% vs. 2798, 475, 17%); T2W (166, 116, 70% vs. 979, 560, 57%); T2W-FS (165, 137, 83% vs. 1081, 512, 47%); Cirrhosis: In-phase T1W (196, 100, 51% vs. 2667, 553, 21%); Opposed-phase T1W (183, 100, 55% vs. 2773, 546, 20%); Fat-suppressed opposed-phase 3D T1W (165, 110, 67% vs. 2734, 568, 21%); T2W (215, 170, 79% vs. 1019, 570, 56%); T2W-FS (163, 161, 99% vs. 1064, 552, 52%).

CONCLUSION

Intensity inhomogeneity correction and intensity standardization may be useful to make MR image intensities have a tissue-specific numeric meaning. This novel approach may be useful to improve the detection and characterization of cirrhosis on MRI.

CLINICAL RELEVANCE/APPLICATION

MR intensity standardization may help to detect and quantify differences between normal and cirrhotic livers compared to non-standardized MRI.

GIS360

Comparison of the Accuracy between Liver and Spleen Elastography Using Acoustic Radiation Force Impulse and Other Noninvasive Tests in Predicting the Presence of Esophageal Varices (Station #2)

Jaehyung Park (Presenter): Nothing to Disclose, Kwon Hee-jin : Nothing to Disclose, Kyungjae Lim : Nothing to Disclose, Jinhan Cho : Nothing to Disclose, Jong-Young Oh : Nothing to Disclose, Kyung Jin Nam MD : Nothing to Disclose

PURPOSE

Purpose: This study aimed to evaluate the accuracy of liver elastography, spleen elastography, and other noninvasive tests (aspartate aminotransferase-alanine aminotransferase ratio, APRI (AST platelet ratio) score, platelet count, and platelet/spleen ratio) in predicting the presence of esophageal varices in liver cirrhosis.

METHOD AND MATERIALS

We studied 197 consecutive patients with hepatitis B virus (HBV) (n = 97), hepatitis C virus (HCV) (n = 59), or alcohol-induced liver cirrhosis (n = 41) who underwent biochemical tests, gastrointestinal endoscopy, and liver and spleen elastography by acoustic radiation force impulse (ARFI). The median liver and spleen stiffness values from 5 successful measurements per participant were obtained.

RESULTS

Result: Among the patients with a valid measurement, 43 % had no esophageal varices, whereas the others had esophageal varices. On univariate analysis, the platelet count, platelet/spleen ratio, and spleen elastography were independently associated with esophageal varices. However, in cases of alcohol-induced liver cirrhosis, spleen stiffness was not reliable for prediction of esophageal varices and also spleen stiffness measurement are less reproducible than liver stiffness measurement.

CONCLUSION

Conclusion: The liver and spleen stiffness values measured by ARFI elastography are well correlated, and spleen stiffness measured by ARFI can potentially be used as a non-invasive method for determining the presence of esophageal varices. However, the evidence supporting a similar role for replacing endoscopy is lacking because spleen stiffness is less reproducible compared to liver stiffness and, further, it is not an appropriate predictor for esophageal varices in alcoholic cirrhosis.

CLINICAL RELEVANCE/APPLICATION

Spleen stiffness is potentially good predictor for esophageal varix, but the measurement are less reproducible than liver stiffness.
Efficacy of Interferon-a in the Prevention of Colorectal Cancer Metastases: Assessment by 7 Tesla Liver Magnetic Resonance (MR) in a Mouse Model of Disease (Station #5)

Paolo Marra (Presenter): Nothing to Disclose, Antonio Esposito MD: Nothing to Disclose, Tamara Canu RT: Nothing to Disclose, Giovanni Sita: Nothing to Disclose, Francesco Aldo De Cobelli MD: Nothing to Disclose, Alessandro Del Maschio MD: Nothing to Disclose

PURPOSE
In primary and metastatic liver tumors characterized by neovascularization the accumulation of Tie2-expressing monocytes (TEMs) is common. They are tumor-associated macrophages derived from the hematopoietic system, with pro-angiogenic activity. Our purpose was to genetically modify these cells to express and selectively deliver interferon-α to liver metastases. Antitumor efficacy was assessed by volumetric analyses at MRI in a mouse model of liver CRC metastases.

METHOD AND MATERIALS
Liver metastases were induced injecting 5x10^3 CT26-GFP cells through the splenic vein in 30 CB6F1 mice: 14/26 were previously transplanted with TEMs engineered to express IFNα under the Tie2 promoter (IFN-group); 12/26 were transplanted with TEMs engineered to express green-fluorescent-protein under the Tie2 promoter (Placebo-group); 4/26 control mice were un-manipulated before metastases induction (Control-group). In other 6 of 11 mice injected with metastatic cells, IFNα was administered systemically at a dose of 25µg day. Starting from day 14 after metastases induction serial in vivo liver EOB-DTPA-enhanced MRI analyses with a 7-Tesla scanner were carried out for the detection and the volumetric assessment of metastases.

RESULTS
The incidence of liver metastases was lower in IFN-group than in Placebo and Control groups both at 14 (0% vs 57% vs 50%; p<0.05) and at 34 days (11% vs 100% vs 100%; p=0.002) from CT26-GFP cells injection. 3 IFN-mice that developed metastases at day 21 presented disease remission with no metastases at day 54. Average tumor volume was significantly lower in IFN-group than in Placebo and Control groups with a mean value between time points respectively of 1.53 vs 128.86 vs 38.92 mm³ (p<0.01). At day 54 Placebo and Control mice were dead vs only 11% of IFN-mice (p=0.001). Also the systemic administration of IFNα reduced liver metastases incidence in treated mice (IFN vs Placebo: 0% vs 60% at 14 and 21 days; p<0.05).

CONCLUSION
Selective hepatic or systemic deliver of IFNα seems to prevent CRC metastases in a mouse model of disease: incidence and volume reduction at MRI should be considered a reliable and easy detectable marker of biological efficacy as it correlates with survival rates.

CLINICAL RELEVANCE/APPLICATION
MR is a reliable and practical tool for the evaluation of efficacy of new therapies in mouse models of disease: with it, a potential reduction of the time required for the preclinical experimental phase may be achieved.

Diagnostic Value of CT- localizer and Axial Low-dose Computed Tomography for the Detection of Drug Body Packing (Station #6)

Joel Aissa (Presenter): Nothing to Disclose, Christian Rubbert MD: Fellowship funded, Koninklijke Philips NV, Patrick Kroepil MD: Nothing to Disclose, Christoph Schleich: Nothing to Disclose, Gerald Antoch MD: Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Falk Roland Miese MD: Nothing to Disclose

PURPOSE
Body packing is an increasingly upcoming form of contraband worldwide. Due to the limitations of conventional radiography low dose computed tomography (CT) has been established as method of choice for detecting illicit drugs. Omission of abdominal CT in cases with positive CT- localizer leads to a further reduction of radiation dose. The purpose of this study was to assess the diagnostic performance of CT- localizers in the detection of illegal body packets.

METHOD AND MATERIALS
108 patients (86 men, 19 women; mean age, 34.3 ± 8.7 years (range, 18-56 years) were included into this study. All suspects were referred to our institute between March 2012 to March 2013. Presence of body packs was assessed in consensus by two radiologists with two and seven years of professional experience. The blinded observers compared the CT- localizer and the axial low dose CT images. Positive predictive value and negative predictive value, sensitivity and specificity of the CT- localizer were calculated.

RESULTS
The sensitivity of CT- localizer for detection of packs was 0.68 (19 of 28), and specificity was 1.00. In 28 (26%) of 108 cases packs were detected in axial CT images. Packets were discovered in the CT- localizer of 19 (18%) suspects. There were no cases assessed as false positive. The omission of the axial low dose CT-images would have led to a mean radiation dose reduction of 2.0 ± 0.5 mSv in this study. The positive predictive value was 1.0 and the negative predictive value was 0.89.

CONCLUSION
The value of CT- localizers lies in their high PPV. They are limited by low sensitivity, compared to axial CT images in detection of potential body packers.
In positive cases the high PPV of CT-localizer may possibly allow to omit the full axial low dose abdominal CT to get even lower radiation exposure.

The Natural History of Incidental Cystic Pancreatic Lesions Less than 3cm: Results of Mid-term Follow-up and Clinical Significance (Station #7)

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

PURPOSE

To restrospectively determine natural history of incidentally detected focal cystic pancreatic lesions (CPLs) less than 3cm with an average imaging follow-up (F/U) of 34 months.

METHOD AND MATERIALS

Throughout a 60-month period, a cohort of patients with incidental CPLs were identified using a computerized search. Patients, who fulfilled all of following criteria, were enrolled in this study; 1) available CT or MR images with F/U interval more than 6 months, 2) CPLs that were unilocular, 3) CPLs less than 3cm in size, 4) CPLs that were not given any specific diagnosis on initial CT or MR images, 5) no symptoms referable to pancreas, 6) no history of pancreatitis. CT and MR images were analyzed regarding location and size of CPLs. According to interval size change, CPLs were divided into three groups (increase, no change, decrease).

RESULTS

Among 1514 patients with incidental CPLs, 565 patients were confirmed to meet inclusion criteria. While 495 patients had one CPL, 70 patients had more than two CPLs. The mean size of 661 CPLs in 565 patients was 11.7 mm on initial CT or MR images. Regarding location, 661 CPLs were located in head (n=241), neck (n=92), body (n=200) and tail (n=168). During F/U, 14 CPLs were confirmed as benign (n=11) and malignant (n=3). Fourteen CPLs with pathological diagnosis were classified into interval increase (n=5), no change (n=5), and interval decrease (n=4) group, respectively. Per-lesion-based analysis showed that 661 CPLs increased in 23% (152 CPLs), did not change in 69.9% (462 CPLs) and decreased in 7.1% (47 CPLs) during F/U. The mean size of 152 CPLs that showed interval increase was 12.1 mm and 19.8 mm on initial and final F/U images, respectively, among which 85.5% (130 CPLs) were still less than 3cm on final F/U images. While two (1.5%) of enlarged 130 CPLs less than 3cm were pathologically confirmed as benign (n=2), three (13.6%) of enlarged 22 CPLs greater than 3cm were confirmed as malignant (n=3).

CONCLUSION

Our data suggest that 152 CPLs (23%) of incidental CPLs of 3cm or smaller showed interval increase during a mean F/U of 34.2 months, among which 130 CPLs (85.5%) were still negative for malignancy in the last F/U imaging.

CLINICAL RELEVANCE/APPLICATION

Although incidental cystic pancreatic lesions of 3cm or smaller could increase in size, most of asymptomatic CPLs can be observed safely, at least for a mean period of 3 years.

Sclerosing Cholangitis: Guide to Navigate through Winding and Bumpy Bile Ducts (Station #8)

Nieun Seo MD (Presenter): Nothing to Disclose, So Yeon Kim MD : Nothing to Disclose, Jin Hee Kim MD : Nothing to Disclose, Seung Soo Lee MD : Nothing to Disclose, Seong Ho Park MD : Research Grant, DONGKOOK Pharmaceutical Co, Ltd Research Grant, General Electric Company, Hyo Jung Kim MD : Nothing to Disclose, Jae Ho Byun MD : Nothing to Disclose, Moon-Gyu Lee MD : Nothing to Disclose

TEACHING POINTS

1. To outline the current concept in sclerosing cholangitis
2. To present an imaging atlas of sclerosing cholangitis with relevant clinical features and pathogenesis
3. To discuss the risks and imaging characteristics of cholangiocarcinoma in patients with sclerosing cholangitis
4. To establish a systematic approach to the differential diagnosis of sclerosing cholangitis

TABLE OF CONTENTS/OUTLINE

1. Introduction of the current concept in sclerosing cholangitis
2. Disease spectrum, clinical significance, and imaging findings
   (1) Primary sclerosing cholangitis
      i. Definition
ii. Clinical significance
iii. Imaging features

(2) Secondary sclerosing cholangitis

i. Etiology: IgG4-related sclerosing cholangitis, recurrent pyogenic cholangitis, ischemic cholangiopathy, AIDS cholangiopathy, Eosinophilic cholangitis, Portal biliopathy

ii. Clinical significance
iii. Imaging features characteristic to different etiologies

(3) Risk of cholangiocarcinoma: Associated etiology and image features

3. Systematic approach to differential diagnosis of sclerosing cholangitis
Imaging of Rectal Pathology by MRI with Aqueous Jelly: The Magical Key! (Station #12)

Dharmesh Prabhakar Vasavada MS (Presenter): Nothing to Disclose, Nandini Bahri MD: Nothing to Disclose

TEACHING POINTS

After reviewing of this article, readers will: To differentiate the early stages of carcinoma like T1 and T2 from mucosal thickening, collapsed rectum, and polyp. To plan the coronal images perpendicular to axial images in distended rectum to avoid partial volume effect and to accurately evaluate the depth of tumor and length of tumor for surgery. To see the distensibility and delineate the intact mucosa in case of lesions like lymphoma and GIST of recto-sigmoid junction

TABLE OF CONTENTS/OUTLINE

Introduce nearly 100 ml sterile aqueous jelly in the rectal lumen and use surface array coils to do MRI for rectal pathologies. The advantage of jelly: Water based contrast with or without gadolinium requires pressure effect like foley's bulb to be retained in the rectum up to the completion of MR examination and that causes impact on the ability of MRI to detect the exact distance between tumor and potential resection margin. And patients with abdominal discomfort shows very low compliance to this technique. While jelly distends the rectum optimum enough to visualize the lumen and help to differentiate the above mentioned rectal pathology without giving false impression of potential resection margin as there is no pressure effect required and patient compliance is high as there is no need to distend entire large colon.

Gastrointestinal Fluoroscopic Techniques with Cross-sectional and Pathologic Correlation: What the Resident Must Know to Deliver a Quality Examination (hardcopy backboard)

Leonardo Ivan Valentin MD (Presenter): Nothing to Disclose, Erik Soloff MD: Nothing to Disclose, Rafael Andres Vicens-Rodriguez MD: Nothing to Disclose, Crystal Trujillo MD: Nothing to Disclose

TEACHING POINTS

1. To define expectations and milestones when performing fluoroscopy in residency. 2. Knowledge of the normal and abnormal imaging appearances of the gastrointestinal tract is essential in order to maximize the quality, sensitivity, and appropriate interpretation when performing fluoroscopy studies. 3. Correlate abnormalities initially detected on fluoroscopy with its appearance in computed tomography, magnetic resonance imaging, and positron emission tomography; in addition to endoscopic and pathologic appearance.

TABLE OF CONTENTS/OUTLINE

Introduction Gastroesophageal Anatomy Normal appearance of the gastrointestinal tract in Fluoroscopy Overview of pathology identified by Fluoroscopy (Clinical Cases with cross-sectional and pathologic correlation) Technical Details at Our Institution Conclusion

Impact of Postoperative Changes of the Membranous Urethra Angle on the Outcome after Retrourethral Transobturator Sling for Treating Post Prostatectomy Incontinence (Station #1)

Sonja Kirchhoff MD (Presenter): Nothing to Disclose, Olga Solyanik MD: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose, Irina Soljanik: Nothing to Disclose

PURPOSE

The aim of the study was to evaluate the outcome after retourorethral transobturator sling (RTS) for treating post-prostatectomy incontinence (PPI) using functional magnetic resonance imaging (MRI) for identifying parameters associated with RTS failure and to assess the reliability of the measurements.

METHOD AND MATERIALS

Thirty men with PPI consecutively underwent cine-MRI before and 12 months after RTS placement in a sequential clinical observational study. T2-weighted turbo spin echo (TSE) sequences in axial and sagittal orientation were acquired to analyse anatomical structures and to plan the dynamic examination of the pelvic floor (PF). Sagittal TrueFISP (Fast Imaging with Steady State Precession) sequences during the Valsalva maneuver (VM) and micturition were acquired in terms of functional imaging. The membranous urethra angle (AMU), the distance between the bladder neck (BN) and the pubo-coccygeal reference line (PCL) and the distance between the external urinary sphincter (EUS) and PCL during maximal VM and voiding were evaluated. Two radiologists performed the measurements independently for intrarater reliability. Intrarater reliability was assessed by the same radiologist performing the evaluation 6 weeks after the first analysis. RTS success rate
was defined as no or one dry "security" pad use.

RESULTS
The success rate was 60% (18/30 patients). The median follow-up was 32.5 months (range: 16-39 months). The AMU was significantly reduced postoperatively during maximal VM (39.55 vs. 36.82, p = 0.025) and voiding (38.25 vs. 34.83, p = 0.001). The EUS was significantly elevated (2.9 vs. 4.8 mm, p = 0.017) postoperatively. The RTS failure was significantly associated with slighter postoperative AMU-change during voiding (p = 0.001). The interrater and intrarater reliability of the assessed parameters was excellent (ICC>=0.75).

CONCLUSION
RTS placement leads to AMU reduction and EUS elevation on cine-MRI. Only slight AMU changes after sling placement seem insufficient for RTS success. However, Cine-MRI of the male PF appears to be a reliable tool in the evaluation of RTS-outcome.

CLINICAL RELEVANCE/APPLICATION
Cine-MRI of the male pelvic floor appears to be a reliable tool in the evaluation of the outcome after RTS-placement for treating post prostatectomy incontinence.

GUS127
Study of Clear Cell Renal Cell Carcinoma and Papillary Renal Cell Carcinoma by Applying Magnetic Resonance Diffusion Kurtosis Imaging: A Preliminary Study (Station #2)

Jingtao Wu : Nothing to Disclose, Qingqiang Zhu (Presenter): Nothing to Disclose

PURPOSE
To characterize Magnetic Resonance Diffusion Kurtosis Imaging (DKI) in the study of clear cell renal cell carcinoma (CCRCC) and papillary renal cell carcinoma (PRCC).

METHOD AND MATERIALS
Twenty-four patients with CCRCC and 22 patients with PRCC were retrospectively studied. Tumor DKI features (b value = 0, 300, 600 s/mm²), including Mean Diffusivity (MD), Fractional Anisotropy (FA), mean kurtosis (MK), radial kurtosis (RK), kurtosis anisotropy (KA), were assessed and investigated. Evaluated DKI features were compared between two tumor types by applying independent-sample t test.

RESULTS
In all subjects good image quality was achieved. Statistically significant differences were observed in the properties under evaluation between CCRCC group and PRCC group. MD: (7.13±1.19 vs 0.686±0.109, P<0.05); FA: (0.728±0.113 vs 0.764±0.108, P>0.05); MK: (0.336±0.256 vs 2.25±1.12, P<0.05); KA: (0.496±0.137 vs 2.89±1.11, P<0.05); RK: (0.323±0.216 vs 9.07±7.03, P<0.05). For differentiating CCRCC from PRCC, combined evaluation of MD, FA, MK, KA and RK features was found to have a accuracy of 97.8%.

CONCLUSION
Our initial results indicate the feasibility of DKI in differentiating CCRCC from PRCC. Future studies in patients with kidney diseases are required to determine the value of DKI for functional kidney imaging.

CLINICAL RELEVANCE/APPLICATION
Strictly limited amount of topics involving DKI method in the study of oncology. And this is the only option throughout the section. Our initial results indicate the feasibility of DKI in differentiating CCRCC from PRCC. Future studies in patients with kidney diseases are required to determine the value of DKI for functional kidney imaging.

GUS128
Effective Atomic Number Accuracy for Urinary Stone Characterization Using Gemstone Spectral Imaging (GSI) on Spectral CT (Station #3)

Xiaohu Li (Presenter): Nothing to Disclose, Bing Liu MD: Nothing to Disclose, Yu Yongqiang MD, PhD: Nothing to Disclose

PURPOSE
To evaluate the accuracy for Urinary Stone Characterization using Effective Atomic Number(Zeff) on spectral CT

METHOD AND MATERIALS
Twenty freshly excised pig kidneys with 120 extracted human Urinary stones in them (two in the upper calices, two in the renal pelvis, two in the lower calices of each kidney) which were immersed in a 15cm-deep water tank underwent GSI using spectral CT (Discovery CT750 HD). All data were transferred to Workstation (AW4.4, GE Healthcare) GSI Viewer to obtain Effective Atomic Number(Zeff) images for measurement of the mean Zeff. The mean Zeff was compared among the stone groups. The composition of stones was determined by infrared spectrom

RESULTS
Dual energy imaging is dependent upon accurate attenuation measurements. From our observations we find that the Zeff measurements closely match expected values. The measured Zeff correlates well with the analytically calculated Zeff for each stone type. Our results showed good separation in effective Z for Uric Acid vs. Cystine/Struvite group vs. Calcium based stones. There was some overlap between the Cystine and Struvite stones. However, in conjunction with density measurements, we are able to differentiate all 4 stone types. We color coded the stones using a threshold in Zeff combined with a threshold in density.

CONCLUSION

The combination of effective atomic number and monochromatic attenuation demonstrated good separation of all four stone types considered - even Cystine and Struvite which have poor separability in conventional CT. These results are encouraging and motivate further study to confirm the role of spectral CT in the diagnostic imaging of urinary stones.

CLINICAL RELEVANCE/APPLICATION

Determination of stone composition by Effective Atomic Number can help urologist choose the optimal treatment project to minimize complications and costs.

GUS129

Split-bolus Portal Venous Phase Dual-Energy Computed Tomography Urography: Protocol Design, Image Quality and Dose Reduction (Station #4)

Lo-Yeh Lee MD (Presenter): Nothing to Disclose, Chiao-Yun Chen: Nothing to Disclose, Gin Chung Liu MD: Nothing to Disclose, Twei-Shiun Jaw MD: Nothing to Disclose, Jui-Sheng Hsu MD, PhD: Nothing to Disclose, Ming-Lai Dorothy Lai: Nothing to Disclose, Ming-Chen Paul Shih MD: Nothing to Disclose

PURPOSE

To evaluate the image quality of a second-generation dual-source dual-energy computed tomography (DECT) scanner using the split-bolus portal venous phase CT urography protocol and the potential radiation dose reduction by eliminating the need for a nonenhanced scan.

METHOD AND MATERIALS

Our institutional review board approved this retrospective study and waived informed consent. DECT urography was performed in 84 patients. Non-enhanced CT scan was performed 20 minutes after drinking of 800mL water. The split-bolus protocol consisted of a sequence of injections (200mL of normal saline [2.0mL/s], 50mL of contrast medium [2.5mL/s] at 0 second, and 70mL of contrast medium [2.5mL/sec] at 420 second) and a saline flush of 25mL thereafter. Scan started at 480 second. Virtual nonenhanced (VNE) images were reconstructed from enhanced DECT scans. The mean CT density and signal-to-noise ratio (SNR) of the upper urinary tract, renal parenchyma, vessels, renal/urothelial tumors, normal reference tissues, and image noise were measured. Image quality was rated by two radiologists.

RESULTS

Opacification of the intrarenal collecting system, proximal, middle, and distal ureters, and bladder was complete in 92.9%, 83.9%, 78.6%, 77.4%, and 26.2% of patients, respectively. Image quality of the renal parenchyma, arteries, and veins was excellent in 59.5%, 75%, and 97.6% of cases. The mean CT density of renal/urothelial tumors (n=16) was 90.9HU±6 in enhanced images, 31.7HU±2 in true nonenhanced (TNE) and 36.3HU±2 in VNE images. The SNR of all measured lesions except renal pelvis showed significant correlation (p<.01) between the TNE and VNE images. The overall sensitivity of stone detection was 87.5% (28 of 32; 95% CI: 70.4%, 95.4%) in VNE images. If the TNE would be omitted, the dose of this protocol could reduce from 15.6mSv to 6.7mSv.

CONCLUSION

Our single portal venous phase split-bolus protocol provides sufficient opacification of upper urinary tract collecting system, good enhancement of vessels, renal/urothelial tumors and potential to reduce radiation exposure.

CLINICAL RELEVANCE/APPLICATION

Our split-bolus portal venous phase DECT urography protocol is timed to acquire good corticomedullary-nephrographic-excretory phase and vascular/tumor enhancement data and provide sufficient opacification of the collecting system. The “all-in-one” protocol has the inherent advantage of omitting the non-contrast scan, thus reducing the radiation dose.

GUS130

Detection of Bladder Cancer: Comparison of Low Dose Scans Using Adaptive Iterative Dose Reduction 3D and Routine Dose Scans Using Filtered Back Projection in CT Urography (Station #5)

Hiroshi Juri (Presenter): Nothing to Disclose, Takahiro Tsuboyama MD: Nothing to Disclose, Seishi Kumano MD: Nothing to Disclose, Kazuhiro Yamamoto MD: Nothing to Disclose, Haruhiyo Azuma: Nothing to Disclose, Yoshifumi Narumi MD: Nothing to Disclose

PURPOSE

To prospectively compare the diagnostic ability of low dose scans with adaptive iterative dose reduction 3D (AIDR 3D) and routine dose scans with filtered back projection (FBP) for the detection of bladder cancer on the excretory phase (EP) in CT urography.

METHOD AND MATERIALS
Forty-two patients known to have or at high risk for urothelial carcinoma were included. Routine and low dose EP of CT urography were performed at 15 minutes after administration of contrast material. Low dose images were reconstructed with AIDR 3D and routine dose images were reconstructed with FBP. Two radiologists independently scored the confidence levels for the presence or absence of bladder cancer using 5-point scale, and the number of tumors in the urinary bladder was recorded on each EP. Differences were resolved by consensus. Standard of reference was obtained from histopathologic findings or cystoscopy. In addition, one radiologist measured the maximum diameter of the tumor of each patient, and averaged. The CT dose index (CTD1vol) was measured and the percentage of dose reduction was calculated.

RESULTS

Bladder cancer was revealed in 23 patients by cystoscopy. The mean maximum diameter of the tumors of each patient was 32.8 mm (range; 5.7 - 101.3 mm). Sensitivity, specificity, and accuracy were 87.0%, 94.5%, and 90.5% on routine dose, and were 87.0%, 89.5%, and 88.1% on low dose scans, respectively, and there was no significant difference. Area under the receiver operating characteristic curves for detecting cancer was 0.915 and 0.901 on routine and low dose scans, and there was no significant difference (p = 0.263). The number of tumors in the urinary bladder on low dose scans was almost equal to that on routine dose scans in all patients with bladder cancer. The average CTD1vol was 8.07 mGy and 2.61 mGy on routine and low dose scans, and the percentage of the dose reduction with low dose scans was 67.8%.

CONCLUSION

The diagnostic ability of low dose scans with AIDR 3D is almost equal to that of routine dose scans with FBP on the EP in CT urography. The dose reduction is nearly 70% using AIDR 3D.

CLINICAL RELEVANCE/APPLICATION

Using AIDR 3D, we can perform nearly 70% dose reduction without worsening the diagnostic ability for the detection of bladder cancer on the excretory phase in CT urography.

GUS131

MRI Features of Non-palpable Leydigomas of the Testis (Station #6)

Valeria Vinci MD (Presenter): Nothing to Disclose, Lucia Manganaro MD: Nothing to Disclose, Matteo Saldari MD, PhD: Nothing to Disclose, Silvia Bernardo MD: Nothing to Disclose, Andrea Isidori: Nothing to Disclose, Carlo Catalano MD: Nothing to Disclose, Paolo Solazzo MD: Nothing to Disclose

PURPOSE

This study aimed to summarize an important finding we experienced in our study regarding the MRI features of Leydigomas.

METHOD AND MATERIALS

In 2 years time, we performed around 130 MRI of the testis for suspected testicular lesions found on a previous ultrasound, all patients underwent surgery within one month from MRI. Of these we included in this study 42 cases in which the Histological diagnosis reported Leydigomas. We evaluated the Radiologists suggestion based on the evaluation of margins, signal intensity on both T1 and T2 w sequences, and contrast enhancement behaviour (on dynamic acquisition).

RESULTS

In 38/42 cases Radiologists had suggested the presence of Leydigomas, these lesions presented defined margins, very low intensity signal on T2 weighted sequences and iso-hypointense signal on T1 weighted sequences, moreover these lesions were characterized by an hypervascular pattern with high peak at 1st minute (between 20" and 40"). In 4 cases Radiologists had suggested a Seminomatous origin due to the blurred margins and slow enhancement peak. We achieved a 100% sensibility and a positive predictive value of 90%.

CONCLUSION

This study suggest an increasing role for MRI in the characterization of testicular lesions; thanks to the high sensibility, the Radiologist may help clinicians and surgeons to choose the best therapeutic options in favour of a conservative approach instead of a radical orchitectomy, also in light of fertility context.

CLINICAL RELEVANCE/APPLICATION

MRI examination is validated third level method of imaging in a diagnostic algorithm of the testes, which may help to characterize benign lesions in order to avoid radical orchiectomy in young patients and help clinicians and surgeons to choose the best therapeutic options.

URE149

Beauty of the Groin: Functional Anatomy Yields Simple Diagnostic Strategy (Station #7)

Yuka Morita MD (Presenter): Nothing to Disclose, Mitsutomi Ishiyama MD: Nothing to Disclose, Mariko Okura: Nothing to Disclose, Tomoya Nishiyama MD: Nothing to Disclose, Takeshi Wada MD: Nothing to Disclose, Yasuyuki Kurihara MD: Nothing to Disclose, Kazuhiko Hosoya: Nothing to Disclose, Masaki Matsusako MD, PhD: Nothing to Disclose, Tsutomu Nihei: Nothing to Disclose

TEACHING POINTS
METHODS

scale local clinics and the need for sustainable business models for large scale deployment.

collaboration and communication, ways of working in a resource-constrained country, acceptable funding to

the clinical program uncovered and began to address new roadblocks such as the need for tools that facilitate

to life-saving obstetrical care in LMIC and improving community health outcomes, thereby making progress

social value creation. For ANCs such a clinical program can drive progress in global health by increasing access

Public-private partnerships can create value for all partners (Table 1) by synergizing business objectives with

CONCLUSION

country.

course of the pregnancy. Based upon these clinical and financial results, the Ugandan Ministry of Health has

of government funding was subsidized by an affordable patient co-payment of ~ 5,000 UGX (~$2 US) for the

church-affiliated, 

the ANCs, and a commensurate 70% increase in testing and treatment of co-morbidities. Finally, once

C-sections. Additionally observed were “magnet” effects associated with use of the ultrasound. These included a

placenta previa. This knowledge led to follow-up ultrasound, better-planned deliveries, and/or referrals for

Unexpected or urgent clinical findings were identified in 23% of patients, resulting in successful change in

The clinical program was established at ten, church-affiliated, private rural health clinics. Forty-five midwives

were trained to perform ultrasound scans and 15,000 scans were performed over the course of three years.

TABLE OF CONTENTS/OUTLINE

I. Key structures of the groin region and clinical functionality How to differentiate inguinal canal, vascular space

(lacuna vasorum), and muscular and nerve space (lacuna musculorum)? Let’s brush up our knowledge about

key functional anatomy in connection with clinical presentation. II. Pathologic conditions of the groin region;

The concise approach to differentiate them based on functional anatomy 1) Inguinal canal: direct/indirect

inguinal hernia, hydrocele of the canal of Nuck, epididymitis, spermatic(round ligament) varicocele, hematoma, endometriosis, and neoplasms 2) Vascular space (Lacuna vasorum): femoral hernia, lymphadenopathy, lymphatic malformation, dissection and pseudoaneurysm 3) Muscular and nerve space (Lacuna musculorum): iliopsoas bursitis, abscess, lipoma, ganglion, and neurofibroma In this section, we review pathological conditions of the groin lesion and build up firm understanding of radiologic findings based on functional anatomy.

1) To illustrate the normal structure of groin region highlighting functional anatomy. 2) To demonstrate easy steps to approach pathologic conditions of the groin region based on functional anatomy. 3) To present clinical cases to achieve a comprehensive radiologic understanding of groin region.

HPS-TUB

Health Services Tuesday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits™ .50

Tue, Dec 2 12:45 PM - 1:15 PM Location: HS Community, Learning Center

Sub-Events

HPS157

Antenatal Care in Low- and Middle-income Countries (LMIC) Delivered through a Public-private Partnership (PPP) (Station #1)

Meera Gopalakrishnan PhD : Director, Koninklijke Philips NV, Kristen K. DeStigter MD (Presenter): Research Grant, Koninklijke Philips NV Consultant, Koninklijke Philips NV Medical Advisory Board, McKesson Corporation, Eric Z. Silfen MD : Officer, Koninklijke Philips NV

PURPOSE

Over 80% of maternal and neonatal mortality occurs in areas of high birthrate with limited access to healthcare, such as sub-Saharan Africa [WHO 2010]. Infant and maternal mortality continue to be a major health concern in Uganda. It is estimated that ~6,000 Ugandan women die each year due to pregnancy-related complications and for each 1 who dies, 6 survive with chronic and debilitating health conditions such as fistula. Ultrasound examination is well-recognized as an instrument for early detection of life-threatening complications, allowing for timely referral for appropriate life-saving obstetrical care. Improving access to ultrasound technology has the potential to significantly reduce maternal and neonatal deaths and help countries achieve Millennium Development Goals (MDG) 4 and 5 targets. However, access to affordable ultrasound technology at point-of-care coupled with high-quality care delivery is challenging in highly resource-constrained environments. Addressing the complexity and magnitude of these challenges requires domain knowledge, infrastructure capacity and skill-sets housed in both the public and private sectors. Recognizing this need for public-private sector collaboration, we established an NGO-Commercial-Ugandan government public-private partnership (PPP), social business model that emphasized a combination of grass-roots, point-of-care medicine, low-risk government engagement, and a variety of financial models. As a result, we are evaluating a combination of point-of-care ultrasound technology; an inventive care delivery model; and, strong community engagement for improving the clinical outcomes of antenatal medical care in the LMIC setting.

RESULTS

The clinical program was established at ten, church-affiliated, private rural health clinics. Forty-five midwives were trained to perform ultrasound scans and 15,000 scans were performed over the course of three years. Unexpected or urgent clinical findings were identified in 23% of patients, resulting in successful change in clinical management. High-risk conditions diagnosed late in pregnancy using ultrasound included 18% breech or transverse, 4% multiples (twins/triplets), 2.9% abnormal amniotic fluid volume, 2% low lying placentas, 1% placenta previa. This knowledge led to follow-up ultrasound, better-planned deliveries, and/or referrals for C-sections. Additionally observed were “magnet” effects associated with use of the ultrasound. These included a sustained increase in antenatal care visits (ANCs) and skilled deliveries, first time attendance of husbands at the ANCs, and a commensurate 70% increase in testing and treatment of co-morbidities. Finally, once church-affiliated, private clinics were established, clinic services remained fiscally viable when the current level of government funding was subsidized by an affordable patient co-payment of ~ 5,000 UGX (~$2 US) for the course of the pregnancy. Based upon these clinical and financial results, the Ugandan Ministry of Health has approved, for the first time, a similar co-payment model for patients receiving ANC through this program at public clinics and hospitals, thereby significantly expanding affordable access to antenatal care throughout the country.

CONCLUSION

Public-private partnerships can create value for all partners (Table 1) by synergizing business objectives with social value creation. For ANCs such a clinical program can drive progress in global health by increasing access to life-saving obstetrical care in LMIC and improving community health outcomes, thereby making progress towards MDG 4 and 5 targets. Furthermore, in addition to creating value through the public-private partnership, the clinical program uncovered and began to address new roadblocks such as the need for tools that facilitate collaboration and communication, ways of working in a resource-constrained country, acceptable funding to scale local clinics and the need for sustainable business models for large scale deployment.

METHODS
A PPP collaboration agreement was signed to prospectively evaluate pregnant women cared for at level III rural health clinics. The agreement outlined expectations as well as deliverables. Onsite visits were conducted twice a year to gain insights directly from the patients. Working groups comprised of individuals with complementary skill-sets were established. The working groups met weekly to establish and implement program deliverables. The working groups also served as a forum for disseminating lessons learned and best practices as well as agents for the creation of affiliations with local clinical networks. In addition, the PPP framework allowed autonomy for the program team to make necessary programmatic changes based upon local dynamics in the field. Finally, program metrics included both clinical outcomes and cost of care.

**HPS158**

**Hypothesis Testing and Power for Partially-Paired, Fully-Paired, and Unpaired Screening Trials (Station #2)**


**PURPOSE**

The purpose of this research is to provide novel methods for data, power and sample size analysis for unpaired, partially-paired, and fully-paired screening trials which use the full area under the ROC curve as the outcome.

**METHOD AND MATERIALS**

The partially-paired design is constructed by randomly assigning participants to one of three groups: participants who receive a single screening test, participants who receive the alternative screening test and a third arm of participants who receive both tests. In a fully paired design all participants receive both tests, whereas in an unpaired design all participants are randomized to one of the two tests. When running screening studies in a busy clinic, the fully-paired design may not be feasible. Conducting two examinations on all participants can slow clinic flow. A partially-paired design strikes a balance between efficient study design and clinical acceptability. We propose a novel F test that allows for the analysis of unpaired, partially-paired, and fully-paired designs. Power is calculated using an approximate F distribution. Sample size is estimated by numerically inverting the power function. We use a Monte Carlo simulation to evaluate the Type I error rate and power of the test statistic. We compare our proposed power and sample size estimation to that of a commonly used SAS macro, ROCPOWER. The novel method is applied to estimate sample size for a proposed partially-paired breast cancer screening trial.

**RESULTS**

The novel F statistic has accurate Type I error and power. The power approximations are within 0.045 of empirical estimates for all three trial designs (unpaired, partially-paired, and fully paired). Compared to results from ROCPOWER, the proposed F statistic resulted in smaller sample sizes. The sample sizes for the partially-paired designs fell between the sample sizes for the unpaired and fully-paired designs, with increasing efficiency as the ratio of participants with paired data to total participants increased.

**CONCLUSION**

Our approach provides an accurate approach for data, power and sample size analysis for partially-paired, fully-paired, and unpaired screening trials.

**CLINICAL RELEVANCE/APPLICATION**

The method lets clinicians consider a range of partial-pairing ratios while designing screening trials, yielding studies that maintain power and minimize impact on clinic flow.

**HPS159**

**The Weber Effect; A Multi-Year Experience with Gadopentetate Dimeglumine Administration (Station #3)**

Shima Aran MD (Presenter): Nothing to Disclose, Khalid Walid Shaqdan MD: Nothing to Disclose, Hani H. Abujudeh MD, MBA: Research Grant, Bracco Group Consultant, RCG HealthCare Consulting Author, Oxford University Press

**PURPOSE**

The Weber effect states that adverse event reporting tends to increase in the first two years after introduction of a new agent or a new indication, and then declines. We aim to present our experience with adverse reaction reporting pattern of Gadopentetate Dimeglumine.

**METHOD AND MATERIALS**

IRB approved the retrospective study. Data in the electronic incident reporting system was searched between Jan-01-2007 to Jan-14-2014. Gadopentetate Dimeglumine (Mag) and Gadobenate Dimeglumine (Mul) were studied. Our institution developed new guidelines for the use of gadolinium based contrast agents (GBCAs) due to the risk of developing NSF as a result of Mag administration in May-07. In Oct-07 Mag was replaced with Mul for patients with an eGFR <60 mL/min/m². We continued to use Mag for Other patients. We discontinued the use of Mul in Dec-08 due to concerns about acute allergic reactions. As a result the clinical indications for Mag use were changed again and it was used for all clinical indications based on a newly defined guideline. Table shows the time frame of events.
RESULTS
Of 184,218 injections, 174 (0.09%) patients (mean age: 45.6±15.1) showed allergic reaction, consisted of 48 (27.6%) males and 126 (72.4%) females. The highest rates of reactions were observed in the first year (Period-3; 0.167%) after the change in clinical indications followed by the second year (Period-4; 0.109%). Period-3 was statistically significantly different from all other periods except period-4.

CONCLUSION
A Weber pattern was observed in our study following a change in clinical indications for the use of Mag. As institutions consider changing the type of GBCA they use for their general patient population, they should be aware that the overall risk of adverse events could increase. Considering the influence of Weber effect, the increase in adverse events could be attributed to epidemiologic reporting bias and may not represent a true difference in adverse events based on the pharmacologic structure of the GBCA.

CLINICAL RELEVANCE/APPLICATION
Our investigation showed that the weber effect does happen with GBCAs and that Radiology departments should be aware of this effect when substituting the GBCAs or their clinical indications.

HPS160
Have CT and MR Angiography Replaced Catheter Angiography in Diagnosing Peripheral Arterial Disease? (Station #4)

Manisha Chandrakrant Patel MD (Presenter): Nothing to Disclose , David C. Levin MD : Consultant, HealthHelp, LLC Board of Directors, Outpatient Imaging Affiliates, LLC , Laurence Parker PhD : Nothing to Disclose , Vijay Madan Rao MD : Nothing to Disclose

PURPOSE
Diagnostic catheter angiography (DCA) has been considered the gold standard for diagnosing peripheral arterial disease (PAD), but it has been challenged by CTA and MRA, which are noninvasive and less expensive. Our purpose was to determine whether DCA has been replaced by extremity CTA and MRA in diagnosing PAD.

METHOD AND MATERIALS
Nationwide Medicare Part B databases for 2002-2012 were reviewed. CPT codes for extremity MRA and CTA and supervision and interpretation of extremity DCA were selected. Physician specialty codes were used to classify providers as radiologists, cardiologists, and surgeons. Utilization rates per 100,000 Medicare beneficiaries were calculated.

RESULTS
Among all specialties, the combined utilization rate of all 3 types of angiography increased from 917 per 100,000 in 2002 to 1261 in 2006 (+38%), after which it remained stable until 2010, then declined to 1035 in 2012. The overall rate of MRA and CTA together rapidly increased from 89 in 2002 to 440 in 2006 (+394%), after which it leveled off, then gradually decreased to 331 in 2012. In 2012, 32% of the total procedures were MRA and CTA, up from 10% in 2002. Greater than 85% of MRA and CTA examinations were performed by radiologists. The overall rate of DCA remained stable over the course of the study. However, among radiologists, the DCA utilization rate decreased from 433 in 2002 to 120 in 2012 per 100,000 (-72%), whereas among cardiologists and surgeons together, the overall DCA utilization rate increased from 353 in 2002 to a peak of 578 in 2010 (+64%) before dropping somewhat in 2011.

CONCLUSION
Among radiologists, MRA and CTA have gradually replaced DCA, with 71% of procedures among radiologists in 2012 being MRA/CTA (29% DCA), up from 16% in 2002. While overall utilization of DCA has remained steady, it has risen sharply among cardiologists and surgeons, while dropping sharply among radiologists. The increase among cardiologists and surgeons has occurred despite availability of noninvasive alternatives. The lack of growth of MRA/CTA utilization after 2006 is likely related to multiple factors, including radiology benefits management and copay increases, and the drop in DCA among cardiologists and surgeons in 2011 is likely an apparent decrease related to bundling of invasive procedure codes.

CLINICAL RELEVANCE/APPLICATION
Not applicable

HPS161
30-day Readmission Rate following Transjugular Intrahepatic Portosystemic Shunt (TIPS) Placement: A Single Center Experience (Station #5)

Ammar Sarwar MD (Presenter): Nothing to Disclose , Elliot Tapper : Nothing to Disclose , Douglas Grunwald : Nothing to Disclose , Salomao Faintuch MD : Nothing to Disclose , Raza Malik : Nothing to Disclose , Muneeb Ahmed MD : Nothing to Disclose

PURPOSE
Readmission of patients within 30 days of discharge is a quality metric used by the Center for Medicare and Medicaid Services, which is linked to financial penalties. We examined 30 day re-admissions and outcomes after inpatient transjugular intrahepatic portosystemic shunt (TIPS) procedures at our institution to identify the most common causes for re-admission.

METHOD AND MATERIALS
We searched for all TIPS placed at our institution from May 2003 to May 2013 using CPT codes and review of our interventional radiology database. In total, there were 168 primary TIPS procedures performed with 94 covered stents and 74 uncovered stents. We reviewed electronic medical records, radiology reports, administrative databases and discharge summaries. Of these patients, we evaluated the type of TIPS stent used (covered vs. uncovered), length of stay, readmission rates, 30 day re-admissions and overall mortality.

RESULTS

Between May 2003 to May 2013, 168 primary TIPS were placed in 168 patients (55±11 yrs, 71% male). 83/168 were for refractory ascites and 85/168 were for variceal bleeding. 17/168 procedures required only overnight admission whereas 151 required extended hospitalization (12±12 days). Readmission was required in 31/168 (18%) patients within 30 days of discharge after the TIPS procedure. Causes for readmission included encephalopathy (8/31, 25%), clinical symptoms requiring TIPS revisions (31/6, 19%), ascites or hydrothorax causing shortness of breath (6/31, 19%), acute renal failure (3/31, 9%), sepsis (2/31, 6%) and others (3/31, 9%). Only 1/8 patients with encephalopathy required TIPS reduction. Overall, 7 day mortality was 6/168, 30 day mortality was 19/168 and overall mortality was 64/168 occurring 1-2343 days (431±571 days after TIPS).

CONCLUSION

We report single center results for 30 day readmissions following TIPS placement. The most common reason for readmission is hepatic encephalopathy, which can be medically managed in a majority of patients. Assigning more resources post-discharge to high-risk patients may reduce readmission rates.

CLINICAL RELEVANCE/APPLICATION

30 day readmission rates are a CMS metric with potential financial penalties. There is limited current data on 30 day readmission rates following TIPS placement.

HPE001-b

Treating for Two? How to Manage Contrast Reactions in Pregnant Patients (hardcopy backboard)

Jaspreet Kaur Bisla MD (Presenter): Nothing to Disclose, Jeanne Miriam Horowitz MD: Nothing to Disclose, Frank H. Miller MD: Nothing to Disclose, Carla Branco Harmath MD: Nothing to Disclose, Nancy A. Hammond MD: Nothing to Disclose, Vahid Yaghmai MD: Nothing to Disclose

TEACHING POINTS

1. Review the types of contrast reactions (allergic-like and physiologic reactions to intravascular iodinated contrast) 2. Describe the symptoms of contrast reactions unique to pregnant patient 3. Review management guidelines for contrast reactions in pregnant patients, with attention to medications administered and what to do in case of anyphylaxis.

TABLE OF CONTENTS/OUTLINE


INS-TUB

Informatics Tuesday Poster Discussions

Scientific Posters

INS

AMA PRA Category 1 Credits ™ .50

Tue, Dec 2 12:45 PM - 1:15 PM Location: IN Community, Learning Center

Sub-Events

INS153

Planning Complex Surgical Cutting Guides for Le Forte-Based, Maxillofacial Transplantation (Station #1)

Gerald Thomas Grant DMD, MS (Presenter): Nothing to Disclose, Peter Constantine Liacouras PhD: Nothing to Disclose, Ryan J. Murphy MS: Nothing to Disclose, Chad R Gordon DO: Nothing to Disclose, Mehran Armand PhD: Nothing to Disclose

CONCLUSION

Proper alignment of the donor and recipient bony anatomy could potentially decrease future complications and provide a screening tool if multiple donors are available. In efforts to achieve proper alignment, custom surgical guides can be designed and manufactured allowing surgeons to identify and transect precisely on predetermined planes. In addition, earlier identification and surgical cuts will decrease surgical times.
Background

Craniomaxillofacial allotransplantation is currently a new and challenging procedure. Presently, more than twenty patients have received full or partial face transplants. Recently, one of the most current focuses of this procedure is the refinement of the methods and surgical technique used. Creating an optimal hybrid occlusion and facial proportions is difficult and benefits greatly from pre-surgical planning. Using radiographic tools, Digital Software, and Additive Manufacturing (3D Printing) many of the complex steps in these surgeries can be planned in advance.

Evaluation

CT scans of two deidentified cadaver heads were converted with segmentation software to generate volume data used for preoperative planning and visualization. One of the scans was designated as a recipient with a maxillofacial defect. Surgical planes are developed and located on the recipient scan. The intact donor volume is then registered to the recipient scan maintaining the cut planes for the best fit of donor to recipient.

Discussion

Registering the donor scan to the recipient provides the opportunity to evaluate the best fit of donor to recipient. In a situation where there may be multiple donors available, this technique could provide another screening of the donors as one may be a better fit than another. Since the cutting planes slice through both the donor and recipient, by adjusting the plane cuts to accommodate the cutting blades, the guides provide the best opportunity for exacting fit of the two boney sections.

INS154

Prostate MRI Structured Reports Co-connectible to Pathology Synoptic Report Structure Promote Improved Cancer Therapeutic Pathway Decision-making (Station #2)


CONCLUSION

Radiology and pathology reports that share format and semantic elements can facilitate efforts to audit consistency of healthcare pathway choices in prostate cancer patients and may influence decisions in post-operative care.

Background

Prostate MRI cancer staging is increasingly used in pre-surgical or radiotherapy planning. However, current radiology reporting practices (e.g., RadLex®) have yet to be aligned with the existing Synoptic pathology reporting framework currently implemented by the College of American Pathologists (CAP). The degree of semantic consistency between radiology and pathology reports can affect data search and efforts to audit the consistency of healthcare pathway choices in prostate cancer patients. Additionally, consistency between radiology and pathology reports can influence decisions in post-operative care, specifically with regards to radiotherapy.

Evaluation

A new prostate MRI structured reporting template was constructed. Several radiologic-reportable elements were identified that shared common relevance in radiology and pathology. These were successfully recast in the new radiology report structure to match the pathology Synoptic report format. Each element proffered a choice of responses contained between [ ] delimiters such as [Y/N or Not identified]. These data field headers included: Prostate Size [in cm]; Index Lesion [ ]; Extraprostatic Extension [ ]; Neurovascular Bundle Invasion and Laterality [ ]; Seminal Vesicle Invasion and Laterality [ ]; Staging (TNM). Conventional items, such as clinical request indications, patient demographics, and scan parameters, were also included in the template. A paragraph of free-text findings was allowed along with a summary impression.

Discussion

Coordinated radiology and pathology reports organize information into a clear, consistent, and more accessible format. This framework facilitates data search and enables auditing of healthcare therapeutic pathway choices to optimize clinical outcomes for prostate cancer patients. Furthermore, coordinated radiology and pathology reports promote improved clinical decision-making with regards to post-operative radiotherapy.

INS155

End-Loop Feedback Notifying Ticketing System (ELFNTS): Applying Automated Free-form Report Timeline Queries for Follow-up Examination Planning, Scheduling, and Physician Notification (Station #3)

Jaron Chong MD (Presenter): Nothing to Disclose

CONCLUSION

We believe this design pattern of a closed-loop feedback notification ticket system offers a general-purpose architecture for the development of a variety of valuable quality-assurance projects. Automated messaging allows for a ‘push’ instead of a ‘pull’ delivery model and the flexible notifications system permits both human and machine messaging to be performed yielding significant benefits beyond hard-coded dashboard implementations.

Background

Report timeline search has the potential to query for sequences of clinical or radiological events. However, translating these queries into routine follow-up examinations and clinician verified notification requires a
complete end-to-end ticket and messaging architecture. This project describes the practical implementation of a query and notification system to allow a free-form report search engine to implement examination follow-up planning, scheduling, and physician notifications.

Evaluation

Recurring scheduled nested SPHINX EXTENDED2 queries are utilized to execute report timeline queries on a real-time search index. Using report text, study meta-information, and timeline query result matches, open tickets are generated, continuously re-evaluated, and closed. Upon satisfying of query report criteria, ticket maturity, or chronic persistence of an open-loop, a notification is dispatched to machine and/or human recipients including the RIS, radiologists, referring physician/physician teams, or patients.

Discussion

Using this general-purpose framework, we have been able to address commonly missed/near-miss clinical scenarios that lie below routine clinical practice thresholds and have been able to institute closed-loop quality assurance across a diverse variety of scenarios. We describe application examples involving (1) verification of scheduling of IVC filter retrieval, (2) pulmonary nodule / incidental lesion follow-up, and (3) preliminary report discrepancy notification. Additionally, we describe multi-tiered notifications methods involving e-mail, SMS/FAX gateways, XMPP instant messaging gateways, and POTS Interactive Voice Response software (Asterisk) to allow for reliable verified message delivery in a heterogeneous operating environment.

Automatic Classification of Regional Patterns of Diffuse Interstitial Lung Disease with 3D Features from the Volumetric Chest CT Images (Station #4)

INS156

Yongjun Chang : Nothing to Disclose , Jangpyo Bae MS (Presenter): Nothing to Disclose , Namkug Kim PhD : Stockholder, Coreline Soft, Inc / Jung Won Moon : Nothing to Disclose , Ho Yun Lee MD : Nothing to Disclose , Joon Beom Seo MD, PhD : Nothing to Disclose

PURPOSE

To develop a computer-aided diagnosis (CAD) system to investigate the possible usefulness of 2D and 3D features by measuring the accuracy of regional pattern classification of diffuse interstitial lung disease (DILD) from volumetric chest Dual Energy CT (DECT) images.

METHOD AND MATERIALS

Twenty eight patients with suspected DILD were enrolled from February 2010 to August 2011. All patients underwent surgical biopsy within 3 days from DECT scanning (Somatom Definition Flash) with the dual-energy technique. Preprocessing including noise filtering and threshold-based segmentation of lung and airway using a rib detection and inverse level set algorithm were performed to extract lung with threshold of -130 HU at virtual non-contrast (VNC) images. For training with features, circular regions of interest (ROI) with 10-pixel diameter including normal, ground-glass opacity (GGO), reticular opacity, and consolidation patterns were picked by the two chest radiologists with consensus. For testing, a hundred 2D images randomly selected were manually divided into the four classes in the similar way. For training with 2D and 3D features, 10x10 reticular and 10x10x10 cubic regions were selected respectively. The characteristics of each ROI were represented by thirteen textural features and eleven shape features in 2D and 3D features were extracted. Support vector machine (SVM) classifier were used. Twenty repetitions with five-fold cross-validation were performed to evaluate overall accuracy of these classifiers.

RESULTS

The overall accuracy is 90.47 ± 4.62% for the whole lung classification with the combination of 2D and 3D features, which is significantly enhanced by 8.69% compared with that of 2D features only (paired t-test, p<0.05).

CONCLUSION

We proposed an automatic classification method based on SVM with 2D and 3D image features for DILD in DECT imaging. The experiments using twenty five-fold cross-validations result in 90.47% in mean accuracy, which demonstrates the effectiveness of the proposed CAD system for classifying DILD in DECT images.

CLINICAL RELEVANCE/APPLICATION

This method is useful in computer aided differentiation and quantification of regional disease patterns of diffuse infiltrative lung disease in DECT images, which could be helpful for lessening radiologists' workload by the initial diagnosis of the possible DILD.

3D Printing of Individual Immobilization Devices based on Radiological Imaging to Improve Daily Clinical Procedures in Radiation Therapy (Station #5)

INS157

Roland Unterhinninghofen PhD (Presenter): Nothing to Disclose , Jacob Kuypers : Nothing to Disclose , Mortiz Wade : Nothing to Disclose , Alan Preuss : Nothing to Disclose , Florian Sterzing MD : Nothing to Disclose , Frederik Lars Giesel MD, MBA : Nothing to Disclose , Juergen Debus MD, PhD : Nothing to Disclose , Ruediger Dillmann PhD : Nothing to Disclose

CONCLUSION
By integrating modern radiological imaging and rapid manufacturing techniques with a dedicated algorithmic data processing we propose a completely new approach that is straightforward and significantly improves patient comfort. In the near future it may replace the last manual segment in the radiotherapy workflow by an almost fully automated production line.

**Background**

In radiation therapy patients need to be accurately immobilized in order to hit the tumor target exactly and to prevent damage to healthy tissue. For repeated sessions patient position must be reproducible. Usually immobilization devices are made manually using cast (ScotchCast) or thermoplastic material, which is costly and time-consuming. Especially with the head to be immobilized this causes significant discomfort to the patient.

We developed a new approach to produce individual immobilization devices for the head based on tomographic image data and 3D printing technologies: using in-house developed software, MRI or CT images are processed to generate a surface mesh model of the fixation mask. Subsequently apertures for eyes, nose, mouth, and ears are cut into the mask model. Also, an interface for fixation to the intervention table is added. Finally the mask model is materialized using a Dimension SST1200es 3D printer (Stratasys, Eden Prairie, MN, USA).

**Evaluation**

The concept has been implemented in a prototypical fashion and has proven to be feasible. In a qualitative study with healthy volunteers (N=10) the masks fitted well on the volunteers' faces leaving marginal space for moving. However, with some masks, specific areas of the faces such as eyebrows, nose, or chin experienced uncomfortable stress. A quantitative evaluation of the fixation accuracy is ongoing.

**Discussion**

The main advantage of our solution is that the mask is produced in a completely contact-free way using radiological image data already acquired for planning. It hence improves patient comfort and reduces psychological stress considerably.

Also, our approach has the potential to outsource the production of the masks from the clinics, thereby reducing costs and releasing human resources that were needed for conventional mask production.

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**MIS-TUB**

**Molecular Imaging Tuesday Poster Discussions**

**Scientific Posters**

**MI**

AMa PRa Category 1 Credits™: .50

*Tue, Dec 2 12:45 PM - 1:15 PM  Location: S503AB*

**Sub-Events**

**MIS134**

**Improved Tumor Enhancement with Nanoparticulate Contrast Agent in Computed Tomography by Saturation of Reticuloendothelial System (Station #7)**

Yun Jung Kim MD (Presenter): Nothing to Disclose, Kangtaek Lee: Nothing to Disclose, Bumsang Kim: Nothing to Disclose, Jin Hur MD: Nothing to Disclose, Byoung Wook Choi MD: Nothing to Disclose

**PURPOSE**

To improve enhancement of tumor with a nanoparticulate contrast agent in computed tomography by pretreatment of liposome to saturate reticuloendothelial system (RES), which is expected to slow down the elimination of nanoparticulate contrast agent from the blood through RES.

**METHOD AND MATERIALS**

We first determined the optimal time, amount, and particle size of liposome administration for saturation of RES and the optimal enhancement time point of tumor by a nanoparticulate contrast agent (pegylated gold nano particle; AuNP, 40nm). Lewis lung cancer cells (1 x 106) were inoculated to the thigh of C57BL/6 mice (n=6). Two weeks later after tumor fully had grown, the mice were divided into two groups, 1) liposome-treated group with injection of AuNP after 2 hours from liposome injection (150-400nm) to saturate RES (n=3) and 2) non-treated group with injection of AuNP only (n=3). Micro-CT scan was performed to include liver, spleen, and the tumor immediately before and 48 hours after AuNP injection. The mean increase of tumor enhancement was compared between two groups on the liver, spleen, and the tumor respectively. The immune suppression and recovery were followed by surveying gene expression of TNFa, IL-6, NOS, CD14, and histology of the liver and spleen in separate liposome-treated mice (n=3, 3 respectively).

**RESULTS**

The enhancement of tumor was greater in liposome-treated group than in non-treated group (average 164.8 vs. 48.8). That of spleen was greater in non-treated group than in treated group (average 570.0 vs. 245.1). That of liver was similar between two groups (average 506.1 in treated group vs. 530.4 in non-treated group). The enhancement of tumor in treated group increased to 288% of that in non-treated group. The enhancement of spleen in treated group decreased to 46.9% of that in non-treated group. Decreased level of gene expression of TNFa, IL-6, NOS, and CD14 and decreased number and deformed shape of macrophages by RES saturation almost recovered in 2 weeks.
CONCLUSION

RES saturation by liposome with a tolerable degree of immune suppression is feasible to improve tumor enhancement with nanoparticulate contrast agent.

CLINICAL RELEVANCE/APPLICATION

It will provide the feasibility of reticuloendothelial saturation prior to administration of nanoparticulate contrast agent improving the efficacy with same amount of contrast agents or reducing the amount of administration maintaining same degree of enhancement.

MIS135

MR Imaging of Tumor Associated Macrophages In Pediatric Patients with Malignant Lymphomas and Sarcomas (Station #8)

Tarsheen Sethi MBBS (Presenter): Nothing to Disclose, Jessica Donig BA: Nothing to Disclose, Maryam Aghighi MD: Nothing to Disclose, Samantha Holdsworth PhD: Nothing to Disclose, DITA GRATZINGER: Nothing to Disclose, Heike E. Baldrup-Link MD: Nothing to Disclose, Florette Hazard: Nothing to Disclose, Raffi S. Avedian MD: Nothing to Disclose, Neyssa Marina MD: Nothing to Disclose, Sandra Luna-fineman MD: Nothing to Disclose

PURPOSE

Tumor associated macrophages (TAM) are key components of the tumor microenvironment with a role in the pathogenesis and progression of many tumors. The aim of our study was the clinical translation of a non-invasive technique for imaging TAMs in pediatric tumors based on ferumoxytol-enhanced Magnetic Resonance (MR) Scans, evaluating iron uptake as surrogate for macrophage content and correlating with histopathology.

METHOD AND MATERIALS

15 children and young adults with lymphomas (n=7) and sarcomas (n=8) underwent MR imaging at least 24 hours after intravenous injection of the iron oxide nanoparticle ferumoxytol. MR scans included STIR and T1-weighted SPGR sequences for anatomical assessment of iron uptake and T2* FSPGR and eFGRE sequences for quantitative assessment. Mean T2*-relaxation times of whole tumors were calculated. In addition, tumor regions with intracellular and extracellular iron were differentiated based on STIR and T1-weighted SPGR MR Scans. Histopathology correlation was based on 11 biopsy and 3 tumor resection samples evaluated by Prussian blue stain and macrophage immunohistochemistry markers CD-68 and CD-163. Macrophage content was assessed semi-quantitatively as low, intermediate and strong CD68 and CD163 staining by manual slide review by two pathologists. T2*-relaxation times of whole tumors and tumor areas were correlated with macrophage quantities on histopathology. Macrophage heterogeneity was also assessed on MR Scans and compared with histopathology using McNemar’s test.

RESULTS

The mean T2* relaxation times were 4.53 ms and 6.15 ms for sarcomas and lymphomas respectively. All tumors demonstrated presence of macrophages by immunohistochemistry. Sarcomas showed a heterogeneous distribution of TAM on pathologic evaluation and heterogeneous iron uptake on MR scans, while six out of seven lymphomas showed homogenous TAM distribution and iron uptake. A McNemar's test revealed no significant difference in assessment of homogenous or heterogenous TAM distribution by histology or imaging (p value =1.00).

CONCLUSION

Our study represents the clinical translation of a non-invasive method for TAM imaging based on ferumoxytol enhanced- MR scans with histopathology correlation.

CLINICAL RELEVANCE/APPLICATION

The presented ferumoxytol enhanced-MR based technique is immediately clinically applicable and allows for a non-invasive imaging of TAM, a potential marker for prognosis and immunotherapy response assessment.

MIS136

Role of Tumor Texture Analysis on CT Image and Tumor Metabolism Measured by FDG-PET in the Management of Non-small Lung Cancer Patients (Station #9)

Koichi Hayano MD (Presenter): Nothing to Disclose, Naveen Kulkarni MD: Nothing to Disclose, Fang Tian MD: Nothing to Disclose, Dushyant V. Sahani MD: Research Grant, General Electric Company

PURPOSE

Aerobic glycolysis in cancer cells involves elevated glucose uptake. On the other hand, heterogeneity in the structure or blood supply is a well recognized feature of malignancy. The purpose of this study is to compare computed tomography texture analysis (CTTA) with tumor metabolism measured by 18F-Fluorodeoxyglucose (FDG) positron emission tomography (PET) and survival in non-small cell lung cancer (NSCLC) treated with combined therapy of nanoparticle albumin-bound paclitaxel (nab-paclitaxel), carboplatin and bevacizumab.

METHOD AND MATERIALS

In the phase II clinical trial, 35 patients (17 M / 18 W; median age: 64.0 years) with unresectable or metastatic NSCLC treated with nab-paclitaxel, carboplatin and bevacizumab were enrolled. Median follow-up time was 12.5 months. FDG-PET and non-contrast enhanced (CE) CT were performed before the therapy. Tumor texture parameters including mean gray intensity (MGI), Entropy, mean of positive pixels (MPP) were measured on non-CECT images by a texture analysis software (TexRAD, Somerset, UK), where the filtration (spatial scale filter, SSF) extracted features of medium texture scale (SSF=4 mm in radius). Correlations of texture...
parameters with SUVmax were investigated, and those parameters were compared with overall survival (OS) using Cox regression and Kaplan-Meier analysis.

RESULTS
MGI and MPP showed a negative correlation with SUVmax (R=-0.472, P=0.008; R=-0.485, P=0.006; respectively). In univariate Cox regression analysis, SUVmax, MGI, MPP and Entropy showed significant correlations with OS (P=0.03, P=0.02, P=0.04, P=0.0008, respectively). In Kaplan-Meier analysis, higher MGI, MPP, lower SUVmax and Entropy associated with favorable OS (P=0.0008, P=0.0009, P=0.01, P=0.005, respectively). In multivariate analysis, Entropy was identified as an independent prognostic factor of NSCLC (P=0.01; hazards ratio, 4.14; 95% CI, 1.23-25.53) in comparison with SUVmax, MGI, and MPP.

CONCLUSION
Pre-therapeutic tumor texture parameter on non-CECT can serve as a predictive imaging biomarker reflecting tumor metabolism and survival in NSCLC patients treated with nab-paclitaxel, carboplatin and bevacizumab.

CLINICAL RELEVANCE/APPLICATION
CT texture analysis can be a widely applicable noninvasive biomarker for predicting survival in non-small cell lung cancer patients, and it would help select an optimal therapy for those patients.

MIS137
Fluorescence Molecular Tomography of DiR-labeled Mesenchymal Stem Cells Implants in Osteochondral Defects of Rabbit Knees (Station #10)
Markus Thomas Berninger MD : Nothing to Disclose, Pouyan Mohajerani : Nothing to Disclose, Bernhard Haller : Nothing to Disclose, Vasilis Ntziachristos PhD : Stockholder, JThera Medical GmbH, Reinhard Meier MD, PhD : Nothing to Disclose, Tobias D. Henning MD (Presenter) : Nothing to Disclose

PURPOSE
FMT-XCT is a 3D imaging technique that combines the high sensitivity of fluorescence molecular tomography (FMT) with the high resolution of X-ray CT. The purpose of this study was to establish an intermediate sized animal model in a rabbit for FMT-XCT stem cell tracking in the scenario of osteochondral defect repair.

METHOD AND MATERIALS
Mesenchymal stem cells (MSC) were isolated from the bone marrow of New Zealand White rabbits. Then, cells were labeled with the near infrared lipophilic carbocyanine dye DiR (1.25 - 20 μg). Induction of apoptosis and toxicity were assessed by Caspase-3/-7-, Trypan Blue- and XTT-testing. Chondrogenic potential was assessed in pellet cultures (n=3) by measurement of glycosaminoglycans. Labeled cells and unlabeled controls (n=3) underwent FMT-XCT imaging before and after chondrogenic differentiation. Then, osteochondral defects (3.8 x 3.5 mm) were created surgically in the femoral condyle of rabbit knees (n=6) and 200.000 unlabeled and labeled MSC were implanted in a fibrin clot and imaged at FMT-XCT. Statistics were performed using a t-test.

RESULTS
Labeling of MSC with DiR resulted in a strong, significant and dose-dependent fluorescence signal at all concentrations on FMT images (p<0.05). Thus, a labeling concentration of 5 μg DiR was chosen for animal studies. FMT-XCT of labeled MSC after implantation in osteochondral defects showed a strong and significant signal on FMT (p<0.05).

CONCLUSION
MSC could be labeled with DiR without toxic side effects or impairment of chondrogenesis. Labeled cells showed a significant fluorescence signal in vitro and were well depicted by FMT-XCT after implantation in osteochondral defects in a rabbit animal model of cartilage repair.

CLINICAL RELEVANCE/APPLICATION
The use of FMT-XCT in an intermediate sized animal model offers high sensitivity and 3D-image detail. Clinical translation of FMT-XCT could be valid in human follow-up studies in tissue engineering.

MIS138
Optically-assisted Needle Guidance to Differentiate Bile from Liver Parenchyma and Blood (Station #11)
Mohammad Eghtedari MD, PhD : Nothing to Disclose, Cherng Chao MD, JD (Presenter), Saharnaz Baghadchi : Nothing to Disclose, Robert Frederick Mattrey MD : Nothing to Disclose, Sadik Esener : Nothing to Disclose

PURPOSE
To determine if an optical core biopsy needle could be designed from fiber optic cables to differentiate bile from liver parenchyma and blood.

METHOD AND MATERIALS
We developed a prototype fiber sensor based needle consisting of two optical fiber cables with 200 um core diameter and 0.22 numerical aperture assembled in a standard 15 cm 20 gauge. One of fibers was connected to a light source composed of two red and green color laser diodes with a microcontroller to modulate the source lights. The other fiber was used to transmit the backscattered photons detected at the tip of the needle to the detector. Three distinct wavelengths of 520, 630 and 700 nm were selected to determine the location of needle tip (Figure 2). Based on the optical properties of the tissue like absorption coefficient, scattering coefficient, and the anisotropy factor at the selected wavelengths, an algorithm was developed for determining the location of the needle tip using the detected backscattered light. We tested the designed optical core biopsy needle using in a cadaveric poultry model composed of blood, bile and liver parenchyma.

RESULTS
The measured intensity ratio of red to green light in blood was consistently more than 20, while this ratio for liver parenchyma was between 1.2 and 2. The measured intensity ratio of red to green light in bile was less than 0.5. These substantially different intensity ratios allowed easy differentiation of bile from blood and liver parenchyma.

CONCLUSION

An optical core biopsy needle designed and implemented using fiber optic cables could successfully differentiated bile from liver parenchyma and blood in cadaveric poultry specimens.

CLINICAL RELEVANCE/APPLICATION

Our optical fiber based biopsy needle could be used in percutaneous hepatobiliary procedures to identify the needle tip position based on the optical properties of tissue at the needle tip.

MKS-TUB

Musculoskeletal Tuesday Poster Discussions

Scientific Posters

AMAPRA Category 1 Credits ™: .50

Tue, Dec 2 12:45 PM - 1:15 PM Location: MK Community, Learning Center

Sub-Events

MKS372 Performing Lumbar Sympathetic Blocks: A New Technique (Station #1)

Humberto Gerardo Rosas MD (Presenter): Nothing to Disclose

PURPOSE

Injury to the genitofemoral nerve and unsuccessful blockade of the lumbar sympathetic chain are the most common complications following lumbar sympathetic blocks (LSB). Prior studies have shown that conventional techniques lead to either anterior or lateral placement of the needle in respect to the sympathetic ganglia, or placement within the psoas muscle itself leading to suboptimal flow of the injectate. A transdiscal approach was recently advocated to avoid these complications, however the potential for discitis, and accelerated disc degeneration must be considered. The purpose of the study was to evaluate a new paradiscal, extraforaminal technique to perform fluoroscopically directed lumbar sympathetic blocks that would avoid transgression of vital structures and allow appropriate needle placement along the anterolateral aspect of the vertebral body.

METHOD AND MATERIALS

IRB approval and a waiver of consent were obtained for this retrospective HIPAA compliant study. Fluoroscopic spot views and medical records from 73 (45 females, 28 males; mean age 46.3) consecutively performed lumbar sympathetic blocks dating back to March 13, 2008 were retrospectively reviewed. Patients meeting the diagnostic criteria for complex regional pain syndrome with symptoms lasting greater than 6 months refractory to conservative measures were included in the study. Utilizing the transverse process as a guide, the needle was advanced under fluoroscopic guidance to the anterolateral aspect of the vertebral body. Contrast was administered to confirm appropriate needle placement and skin surface temperatures monitored to document the sympathetic response. The response to the injection was determined utilizing a 10 point Visual Analog Score (VAS).

RESULTS

No major complications occurred defined as death, neurovascular injury, injury to the visceral organs, and infection. Minor complications included a single vasovagal response. All 73 injections resulted in a greater than 3°C increase in skin temperature indicating appropriate blockade of the sympathetic ganglia. VAS scores demonstrated a statistically significant reduction in symptoms from baseline to the postprocedure period.

CONCLUSION

This study describes a safe alternative method for performing LSB.

CLINICAL RELEVANCE/APPLICATION

The technique described allows placement of the needle subjacent to the sympathetic ganglia while avoiding transgression of vital structures.
Adhesive capsulitis (AC) is characterized by pain and stiffness in external rotation and abduction of the upper limb; physiatric rehabilitation (PR) is often difficult. The suprascapular nerve (SN) supplies 70% of shoulder sensitive innervation. US visualizes the SN at the level of the spine of the scapula. The purpose of this work is to show that SN block makes a more lasting pain decrease than the intra-articular treatment of capsulitis and makes the PR easier.

METHOD AND MATERIALS

20 patients with clinical diagnosis of adhesive capsulitis were randomized in 2 groups (A=10F, y=45±3.2; B=10F, y=44±3.6). Group A was treated with US-guided intra-articular injection of 5cc of hydrochloride mepivacaine 2%, 40mg of methylprednisolone and 6ml (90mg) of hyaluronate. In group B the US-guided perineural (at the level of the spine of the scapula) injection of 5cc of hydrochloride mepivacaine 2% was added to the treatment. All patients began PR the day of treatment. All patients underwent clinical (VAS scale and ROM index) both before and immediately after the treatment, at 1 week and 1 month.

RESULTS

VAS before: 8.9 (A), 9.1 (B); immediately after: 5.0 (A), 4.8 (B); at 1 week: 6.2 (A), 4.5 (B); at 1 month: 6.1 (A), 4.0 (B) (p<0.01). ROM before: 100° (A), 95° (B); immediately after: 120° (A, B); at 1 week: 130° (A), 150° (B); at 1 month: 135° (A), 170° (B). We had no complications, in particular no deficit of motion. In all patients of group B we visualized the SN by ultrasound.

CONCLUSION

The role of physiatry in rehabilitation and reduction of pain is fundamental. The SN block associated with intra-articular treatment allows an improvement of PR. The SN block has a more lasting effect than intra-articular treatment.

CLINICAL RELEVANCE/APPLICATION

Ultrasound guided SN block is recommended to improve efficacy of rehabilitation in patients with shoulder capsulitis.

MKS374

Imiglucerase Shortage: Effects in Patients with Gaucher Disease (Station #3)

Jose Manuel Morales MD, PhD (Presenter): Nothing to Disclose, Antonio Cano-Rodriguez MD: Nothing to Disclose, Victor Manuel Encinas MD: Nothing to Disclose

PURPOSE

To study the reversibility of therapeutic effects upon interruption of enzymatic therapy after a prolonged shortage of human recombinant glucocerebrosidase treatment (Imiglucerase, Cerezyme® Sanofi), and to determine the posterior replacement by physiological lipids after the restart of it.

METHOD AND MATERIALS

Fourteen patients with Gaucher's disease underwent long-term enzyme replacement therapy in our hospital. All of them had been clinically, biochemically and radiologically stable for at least four years before production of the enzyme was abruptly interrupted. Of these fourteen patients, six were excluded from the study for not having had a previous MRI scan, or for displaying results with artifacts. In the remaining eight, the last MRI scan prior to the beginning of the supply shortage (A: “baseline MRI” scan) was compared with the first of the scans performed when the shortage ended (B: “post-deprivation MRI” scan). To assess the reversibility of the pathological infiltration following the resumption of treatment, we compare this second study with a third MRI scan, performed after the restart of the therapy (C: “post-resumption” MRI).

RESULTS

In seven of these eight patients, a diffuse progression was confirmed in the infiltration of vertebral marrow by pathological Gaucher tissue when the post-deprivation images were compared with images corresponding to the baseline studies. In all of these seven cases, the post-resumption MRI showed a tendency to recover the basal state, following the restoration of the usual enzyme dose.

CONCLUSION

The forced deprivation of enzyme treatment in the population of patients with Gaucher's disease caused by the global enzyme supply shortage which followed the interruption of its production from September 2009 to October 2010, allowed us to confirm, in the majority of our patients, both the reversibility of the therapeutic effects of imiglucerase on bone marrow once its periodic administration is interrupted, and the tendency of this pathological infiltration to disappear following re-administration of this enzyme.

CLINICAL RELEVANCE/APPLICATION

To our knowledge, the accidental world shortage of the enzyme replacement therapy, allows for the first time to prove the reversibility of the therapeutic effects of imiglucerase on bone marrow.

MKS375

The Iliotibial Band in Acute Knee Trauma: Patterns of Injury on MR Imaging (Station #4)
PURPOSE

The appearance of the iliotibial band (ITB) is rarely described in MRI of acute knee trauma. The purpose of our study is to investigate the characteristic patterns of injury seen with injury of the ITB. We hypothesize that injury of the ITB on MRI is associated with internal derangement, in particular anterior cruciate ligament (ACL) tears and posterolateral corner disruption.

METHOD AND MATERIALS

A retrospective review was completed of 200 MRI scans performed for acute knee trauma. Patients were excluded if there was a history of injury over 4 weeks from the time of the scan, septic arthritis, inflammatory arthropathy, previous knee surgery or significant artefact. In each scan, the ITB was scored as normal, minor sprain (Grade 1), severe sprain (Grade 2) and torn (Grade 3). The menisci, ligaments and tendons of each knee were also assessed.

RESULTS

The mean age was 27.4 years (range 9-69). 71.5% (n = 143) patients were male. The ITB was injured in 115 cases (57.5%). The next most common soft tissue structure injured was the ACL in 53.5% (n=107). Grade 1 ITB injury was seen in 90 of these cases (45%), Grade 2 injury in 20 cases and Grade 3 injury in only 5 cases. There is a significant association between ITB injury and ACL rupture (P

CONCLUSION

ITB injury is strongly associated with significant internal derangement of the knee, especially cruciate ligament rupture, posterolateral corner injury and patellar dislocation.

CLINICAL RELEVANCE/APPLICATION

Injury of the iliotibial band on MRI is associated with internal derangement, in particular cruciate ligament rupture, posterolateral corner injury and patellar dislocation.

Pelvic Morphology in Ischiofemoral Impingement (Station #5)

MKS376

Miriam Antoinette Bredella MD (Presenter): Nothing to Disclose, Debora Cristina Azevedo MD: Nothing to Disclose, Adriana Maria De Lima Oliveira MD: Nothing to Disclose, Frank J. Simeone MD: Nothing to Disclose, Connie Y. Chang MD: Nothing to Disclose, Ambrose J. Huang MD: Nothing to Disclose, Martin Torriani MD: Nothing to Disclose

PURPOSE

Ischiofemoral impingement (IFI) is associated with abnormalities of the quadratus femoris muscle and narrowing of the ischiofemoral (IF) and quadratus femoris (QF) spaces. Anatomic variations in pelvic morphology such as a wider inter-ischial distance and femoral neck anteversion may predispose patients to IFI. The purpose of our study was to assess new MRI measures to quantify pelvic morphology which may predispose to IFI. We hypothesized that patients with IFI have a wider inter-ischial distance and increased femoral neck anteversion compared to normal controls.

METHOD AND MATERIALS

The study was IRB approved and complied with HIPAA guidelines. The study group comprised 78 patients with IFI (mean age: 52.2±15.6 y, 68 f, 10 m) and 51 age and gender matched controls. Control subjects underwent MRI of the hip for acute trauma but were otherwise asymptomatic. Two MSK radiologists independently measured IF and QF distance, femoral cross sectional area (CSA) at the level of the lesser trochanter, the ischial angle as a measure of inter-ischial distance, and femoral neck angle as a measure of femoral anteversion. The quadratus femoris was evaluated for edema and atrophy. Groups were compared with ANOVA.

RESULTS

All patients with IFI and none of the controls subjects had abnormalities of the quadratus femoris muscle (p<0.0001). Out of the 78 patients, 14 (18%) had bilateral MRI findings of IFI. Patients with IFI had decreased IF and QF distance (p<0.0001) and increased femoral neck angle (p=0.03) compared to controls. There was a trend toward decreased femoral CSA (p=0.08) in IFI compared to controls.

CONCLUSION

Patients with IFI have increased ischial and femoral neck angles compared to controls. These anatomic variations in pelvic morphology may predispose to IFI. MRI is a useful method to not only assesses the osseous and soft tissue abnormalities associated with IFI but also to quantify anatomic variations in pelvic morphology that can predispose to IFI.

CLINICAL RELEVANCE/APPLICATION

MRI can be used to assess osseous and soft tissue abnormalities associated with IFI and to quantify anatomic variations in pelvic morphology that can predispose to IFI.

Osteoporosis Screening with Computed Tomography: Contrast Media Significantly Affects Bone Signal (Station #6)

MKS377

Esther Pompe MD (Presenter): Nothing to Disclose, Martin J. Willemink MD: Nothing to Disclose, Gwern Reinhout Dijkhuis MD: Nothing to Disclose, Harald Verhaar: Nothing to Disclose, Firdaus Mohamed Hoessein MD: Nothing to Disclose, Pim A. De Jong MD, PhD: Nothing to Disclose

MKS375

MKS376

MKS377
PURPOSE

Osteoporosis could be detected by determining the bone density (BD) in a region of interest (ROI) within a lumbar vertebra on CT. The effect of intravenous contrast media on BD measurements on computed tomography (CT) examinations performed for other indications was evaluated.

METHOD AND MATERIALS

152 subjects (99 without and 53 with malignant renal neoplasm) who underwent both un-enhanced and two contrast-enhanced (arterial and portal venous phase) abdominal CT exams in a single session between June 2011 and July 2013 were included. BD was evaluated on the three exams as CT-attenuation values in Hounsfield Units (HU) in the first lumbar vertebra (L1).

RESULTS

Subjects were stratified based on the presence of malignancies, because BD measurements were significantly higher in the group without malignancies. Mean ± standard deviation (SD) differences in BD measurements were 27.5±56.4 HU (p<0.01) in the un-enhanced phase, 23.6±59.9 HU in the arterial phase (p<0.01) and 19.8±56.5 HU (p<0.01) in the portal phase. CT-attenuation values were significantly higher in contrast-enhanced phases, compared to the un-enhanced phase (p<0.01). In patients without malignancies, HU-values increased from 128.8±48.6 HU for the unenhanced phase to 142.3±47.2 HU for the arterial phase and 147.0±47.4 HU for the portal phase (p<0.01). In patients with malignancies, HU-values increased from 112.1±38.1 HU to 126.2±38.4 HU and 130.1±37.3 HU (p<0.02), respectively. With thresholds of ≤110 HU, ≤135 HU, ≤160 HU to define osteoporosis, measurements in the arterial phase and portal phase resulted in 7-25% false negatives.

CONCLUSION

Our study showed that intravenous contrast injection substantially affects BD-assessment on CT and taking this into account it may improve opportunistic screening for osteoporosis.

CLINICAL RELEVANCE/APPLICATION

An overestimation of bone density due to contrast injection in clinical CT scans could lead to false negative results if used in a screening setting for osteoporosis.

Ultrasound of Morton’s Neuroma: What Are We Really Looking At? (Station #7)


PURPOSE

To correlate the appearance of preoperative ultrasounds of Morton's neuromas with the surgical specimens.

METHOD AND MATERIALS

Nine Morton's neuromas excised between July, 2013 and March, 2014 that had preoperative ultrasounds were evaluated with approval of the IRB. Preoperative ultrasounds were evaluated for neuroma size and appearance. The resected surgical specimens were sonographically evaluated for size and appearance immediately following excision. All pre- and postoperative scans were performed using Philips IU-22 scanners. Specimens were then evaluated pathologically. The appearance and size of the neuromas were compared between the preoperative and postoperative images, and were correlated to the surgical and pathologic appearances.

RESULTS

All specimens were pathologically proven as Morton's neuromas; they showed focal thickening of the nerve at gross examination, and sclerosis and mucoid degeneration of the nerve fascicles and fibrotic thickening of the perineurium histologically. Longitudinal sonography of the specimens demonstrated echogenic focal enlargement of the nerve at the site of the neuroma, measuring 6.9 mm average (range 4 mm to 11 mm). Preoperative images in the longitudinal plane showed a normal fibrillar echogenic nerve extending to a focal heterogenous hypoechoic mass within the webspace which measured 14.3 mm average (range 9 mm to 24 mm). Surgically, all cases had thickened or scarred bursal tissue around the nerve, and interdigital vessels that had to be disentangled from the nerve.

CONCLUSION

The heterogenous hypoechoic intermetatarsal mass that is sonographically considered a "Morton's neuroma" is actually a "neuroma-bursal complex" consisting of the thickened nerve, tangled vessels, and scarred/thickened bursa, that is much larger than the neuroma itself.

CLINICAL RELEVANCE/APPLICATION

Sonographically, Morton's neuromas are actually neuroma-bursal complexes, larger than the neuroma itself.

Ultrasound Guided Lumbar Spine Facet Injections (Station #8)


TEACHING POINTS

MKS378

MKE299
After a short anatomic review of the posterior lumbar spine, introduce the idea that facet joints can be identified and ultrasound guided facet injections performed.

**TABLE OF CONTENTS/OUTLINE**

I. Sonographic and pictorial anatomic review of the lumbar spine
II. Introduction of Ultrasound guided facet injections.
   A. Reasons why this procedure will be beneficial in the future:
III. Research/procedure confirming location in the facet joint.
IV. Discussion

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**Hand & Wrist Masses: MR Imaging with Pathologic Correlation (Station #9)**

Cody Jackson Morris MD (Presenter): Nothing to Disclose, Gina Johnson: Nothing to Disclose, Adam Daniel Singer MD: Nothing to Disclose, Elie Harmouche: Nothing to Disclose, Abhijit Datir MD: Nothing to Disclose

**TEACHING POINTS**

1. To discuss a practical approach for MRI evaluation of hand and wrist masses, including optimal sequences and the use of intravenous contrast.
2. To present the characteristic MRI findings of hand and wrist masses, ranging from common to uncommon, and benign to malignant lesions.
3. To emphasize the understanding of MRI tissue characteristics of hand and wrist masses in correlation with underlying pathologic findings.

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**Imaging of Low Back Pain in Adult and Pediatric Populations: Red Flags, Educational Intervention, and Outcomes (Station #10)**

Dennis Parhar BSc (Presenter): Nothing to Disclose, Ismail Tawakol Ali MBChB, MD: Nothing to Disclose, Savvas Nicolaou MD: Nothing to Disclose

**TEACHING POINTS**

The purpose/aim of this exhibit is to:

1. Demonstrate when low back imaging should be ordered in adult and pediatric populations and to present guidelines with an underlying rationale.
2. Review the benefits, drawbacks, and controversies of the various imaging modalities used in the investigation of low back pain.
3. Identify the radiologic findings of red flags of low back pain in various imaging modalities along with their clinical correlations.
4. Understand the utility of educational intervention as opposed to imaging in patient satisfaction and outcome.

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**Extrinsic Wrist Ligaments for Dummies: Detailed Anatomy on Dissection, Function, and MR Imaging (Station #11)**

Annemieke Milants (Presenter): Nothing to Disclose, Maryam Shahabpour MD: Nothing to Disclose, Michel De Maeseneer MD: Nothing to Disclose

**TEACHING POINTS**

To discuss detailed anatomy of the extrinsic wrist ligaments, illustrated by anatomical dissection. To discuss function and clinical relevance of the different ligaments. To present standard and 3D MR images with thin sections of the extrinsic ligaments.

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**TABLE OF CONTENTS/OUTLINE**

1. The palmar extrinsic ligaments - radioscaphocapitate (RSC) - radiolunotriquetral (RLT) - short radiolunate (SRL) - radioscaphophalunate/ligament of Testut (RSL) - palmar ulnotriquetral (pUT) - ulnolunate (UL) - ulnocapitate (UC). 2. The dorsal extrinsic ligaments - dorsal radiotriquetral (dRT) - dorsal ulnotriquetral (dUT). 3. The midcarpal ligaments (combining extrinsic and intrinsic ligaments) - palmar scaphotriquetral/ligament of Sennwald (pST) - arcuate ligament - triquetrotrapeziumcapitate (THC) and scaphocapitate (SC) - dorsal scaphotriquetral (dST) - triquetrotrapeziotrapezoidal (TTT) - distal part of RSC - scaphotrapeziotrapezoidal complex (STT). 4. Stabilizing function of the extrinsic ligaments. 5. MR Imaging of the extrinsic ligaments (standard and thin section 3D DESS).
Current Concepts of Total Ankle Arthroplasty for Radiologists (Station #12)

Hyojeong Mulcahy MD (Presenter): Nothing to Disclose, Felix Sze-Kway Chew MD: Nothing to Disclose, Jack Anthony Porrino MD: Nothing to Disclose

TEACHING POINTS

Total ankle arthroplasty is becoming the definitive treatment for end-stage, symptomatic arthritis of the tibiotalar joint. More sophisticated designs, stronger materials, improved surgical technique, and broader indications have led to an increased use. This educational exhibit will: 1. Review the current concepts of ankle replacement including various designs and modern surgical techniques. 2. Explain and illustrate the expected imaging appearances. 3. Demonstrate complications, and explain how such failures occur.

TABLE OF CONTENTS/OUTLINE


Trapped in a Tunnel: Ultrasound Imaging of Peripheral Nerve Entrapment Neuropathies (hardcopy backboard)

Srinadh Boppana MD (Presenter): Nothing to Disclose, Eshwar Chandra Nandury MD: Nothing to Disclose, Kamlesh M Chawda MD: Nothing to Disclose, Prashanth Kumar Karnati MD: Nothing to Disclose, Jyothi Reddy MD: Nothing to Disclose, Annapurna Srirambhatla MD: Nothing to Disclose, Balaji Varaprasad Mallula MD: Nothing to Disclose

TEACHING POINTS

Describe the anatomy and imaging of various osteofibrous tunnels in the body using ultrasound. Recognise the normal ultrasound appearances of peripheral nerves. Identification of peripheral nerve entrapments, their location and causes.

TABLE OF CONTENTS/OUTLINE

Introduction: Anatomy, imaging technique and normal appearances Various nerve entrapments (carpal tunnel, guyons canal, cubital tunnel, radial groove, suprascapular notch, inguinal ligament, suprascapular notch, fibular neck, popliteal fossa, tarsal tunnel). Causes including anatomical variants, retinaculae, ligaments, tenosynovitis, bone and joint abnormalities, masses and masslike lesions (neural and perineural). Conclusion

Nuclear Medicine Tuesday Poster Discussions

Dual-phase 11C-Choline PET/CT in the Early Evaluation of Prostate Cancer Recurrence (Station #1)

Carolina Moreno Maldonado MD (Presenter): Nothing to Disclose, Jose Ferrer: Nothing to Disclose, Gemma Cuberas: Nothing to Disclose, Marina Soler MD, PhD: Nothing to Disclose, Merce Moragas: Nothing to Disclose, Eduard Riera: Nothing to Disclose, Jose R. Garcia MD: Nothing to Disclose

PURPOSE

To assess dual-phase 11C-choline PET/CT for differentiating benign from malignant lesions in patients with biochemical recurrence of prostate cancer

METHOD AND MATERIALS

We prospectively studied 56 prostate cancer patients treated by surgery (n=22) or radiotherapy (n=34) who had hypermetabolic foci on 11C-choline PET/CT done for PSA recurrence (1.23-9.9ng/ml). We used the dual-phase technique, calculating the standardized uptake value (SUV) for early (SUVuearly) and late (SUVdelay) acquisitions and the difference (SUVvariation) to determine whether tracer uptake remained stable/increased (accumulative pattern) or decreased (washout pattern). We used t-tests to compare means and ROC analysis (SUVuearly/SUVdelay/SUVvariation vs benign/malignant).

RESULTS

We identified 106 hypermetabolic foci (34 local, 10 inguinal, 34 infradiaphragmatic, 14 supradiaphragmatic, 14 bone). We identified 34 local foci (8 post-prostatectomy and 26 post-radiotherapy). The 8 post-surgical foci had accumulative pattern and recurrence was confirmed (3 histology, 5 follow-up). Of the 26 post-radiotherapy foci, 3 had washout pattern and follow-up ruled-out recurrence; 23 had accumulative pattern and recurrence was
confirmed (14 histology, 9 follow-up). The 10 inguinal foci had washout pattern and were reactive (3 histology, 7 follow-up). The 34 infradiaphragmatic foci had accumulative pattern and were malignant (34 follow-up). Of the 14 supradiaphragmatic foci, the 3 with washout pattern were benign (3 histology) and the 11 with accumulative pattern were malignant (11 histology). Of the 14 foci in bone, 2 had washout pattern and corresponded with signs of spondyloarthropathy. On the ROC analysis, SUV variation best discriminated benign from malignant lesions (area 0.993) followed by SUV delay (0.933) and finally SUV early (0.665).

CONCLUSION

Dual-phase PET/CT with 11C-choline is technically feasible despite this tracer's short half-life and is useful for discriminating benign from malignant lesions. SUV variation accurately discriminated between benign and malignant lesions.

CLINICAL RELEVANCE/APPLICATION

Feasibility of delayed 11C-Choline imaging. New protocol reduces dosimetry. A single attenuation correction CT for both PET. Better discriminates benign or malignant, allows selection treatment.

NMS174

Clinical Correlation of 123I-Ioflupane Brain SPECT with Symptom Chronicity and Laterality in the Assessment of Parkinsonian Movement Disorders (Station #2)

Kaveh Vejdani MD (Presenter): Nothing to Disclose, Razi Muzaffar DO: Nothing to Disclose, Pratap Chand MD: Nothing to Disclose, Medhat M. Osman MD: Speaker, Koninklijke Philips NV

PURPOSE

To correlate the severity of striatal dopaminergic loss with symptom chronicity of Parkinsonism; and to compare clinical symptom laterality with findings on ioflupane imaging.

METHOD AND MATERIALS

123I-Ioflupane (DaTscan) brain SPECT images from 44 patients with Parkinsonian movement disorders were analyzed retrospectively. Ioflupane uptake in the right and left corpora striata was quantified using manually drawn regions of interest (ROI). The occipital lobes were used as background for Ioflupane specific binding ratio (SBR) calculation. SBR was defined as striatal counts minus background counts, divided by background counts. SBR was correlated with patient's symptom duration. Symptom laterality was compared with the visual findings on imaging.

RESULTS

Of 44 patients, 21 were female (age 64.3 ± 10.5, range 47-85) and 23 were male (age 67.5 ± 8.9, range 49-82). Symptom duration ranged from 1 month to 40 years (average 4.7 years). Mean ± SD of striatal SBR was 1.22 ± 0.64. Weak correlation (r² < 0.3) was observed between the duration of Parkinsonian symptoms and the degree of striatal dopaminergic loss, regardless of gender (r² = 0.11 in men, and -0.11 in women). Data on symptom laterality was available in 40 patients. Clinical suspicion for Parkinson's disease was high (HCS) in 20 patients and low (LCS) in the other 20. Ioflupane scan results were normal in 16/20 (80%) of the patients with LCS. In those with HCS, symptoms were unilateral in 3, symmetrically bilateral in 2, and asymmetrically bilateral in 15. Imaging results agreed with clinical symptom laterality in 1/3 (33%) of the unilateral cases, 0/2 (0%) of the symmetrically bilateral cases, and 5/10 (50%) of the asymmetrically bilateral cases.

CONCLUSION

The degree of striatal dopaminergic loss correlates weakly with symptomatic chronicity of Parkinsonism, regardless of gender. Ioflupane imaging findings agree partially with Parkinsonian symptom laterality.

CLINICAL RELEVANCE/APPLICATION

123I-Ioflupane brain SPECT helps in clinical differentiation between Parkinsonian movement disorders with or without a dopaminergic deficit, which require different approaches to therapy. The relationship between striatal dopaminergic density and Parkinsonian symptoms chronicity and laterality is not well understood.

NMS175

Thoracic Non-osseous Lesions Detected in Low-dose CT Images Acquired as Part of Skeletal SPECT/CT Examinations of Cancer Patients (Station #3)

Wolfgang Wust MD (Presenter): Nothing to Disclose, Matthias Stefan May: Speakers Bureau, Siemens AG, Michael Uder MD: Speaker Group Speakers Bureau, Siemens AG Research Grant, Siemens AG, Michael Marcus Leil MD: Research Grant, Siemens AG Speakers Bureau, Siemens AG Research Grant, Bayer AG Speakers Bureau, Bayer AG Research Consultant, Bracco Group

PURPOSE

Hybrid single-photon emission tomographic (SPECT) and X-ray computed tomography (CT) systems are increasingly used in oncologic imaging. With SPECT/CT not only the thoracic spine but also the surrounding soft tissue needs to be evaluated for pathological findings. The purpose of this study was to assess the prevalence of non-osseous findings detectable on low-dose CT datasets from patients studied by thoracic DPD-SPECT/CT.

METHOD AND MATERIALS

119 consecutive oncologic patients (81 breast cancer, 38 with other cancer) who underwent DPD-SPECT CT of
the thoracic region were included in this study. Non-osseous findings on CT were classified as either probably benign or suspicious. Suspicious findings were correlated with additional imaging methods like ultrasound, MRI or CT with contrast medium.

RESULTS

In 80/119 (67%) patients no imaging was performed before SPECT/CT. Only 7/119 subjects (6 %) had no other lesions than bone lesions. In 101/119 (85%) patients lesions found on SPECT/CT images were rated as benign and in 65/119 (55%) patients as suspicious. In 13/119 (11%) patients with previously unknown suspicious lesions on SPECT/CT images suspicious findings were confirmed with additional follow-up imaging methods (MRI, CT with contrast medium).

CONCLUSION

11% of patients referred to SPECT/CT of the thoracic spine for staging of malignant disease had relevant non-osseous lesions detectable on the low-dose CT images which could be confirmed with additional imaging methods. A systematic review of these CT datasets by physicians trained in CT imaging is therefore mandatory.

CLINICAL RELEVANCE/APPLICATION

The relevant incidence of non-osseous suspicious findings in the low-dose CT scans of skeletal SPECT/CT found in our study stresses the need to evaluate these CT images, and this needs to be done by adequately trained physicians.

NMS176

Changes in Pulmonary 18F-FDG PET Uptake Reflect Treatment Response in Patients with Diffuse Parenchymal Lung Disease (Station #4)

Nicholas J. Screaton  BMBCh : Nothing to Disclose , Thida Win : Nothing to Disclose , Joanna C. Porter PhD, FRCP : Advisor, Onyx Pharmaceuticals, Inc Advisor, InterMune, Inc Lynn Millner : Research funded, GlaxoSmithKline plc Francesco Fraioli MD (Presenter) : Nothing to Disclose , Ashley McAllister Groves MBBS : Investigator, GlaxoSmithKline plc Investigator, General Electric Company Investigator, Siemens AG

PURPOSE

Noninvasive markers of disease activity in diffuse parenchymal lung disease (DPLD) are lacking, which is delaying the end points for clinical trials. We investigate the potential of 18F-FDG-PET/CT to assess disease activity and monitor treatment response in DPLD patients with mixed reticular ground glass changes on high resolution computed tomography (HRCT).

METHOD AND MATERIALS

Twenty-one patients (11-male, 10-female, mean age 68±11) with DPLD were prospectively recruited. Two patients had biopsy proven non-specific interstitial pneumonia (NSIP). The other 19-patients had mixed interstitial inflammation and fibrosis consistent with NSIP following multidisciplinary review on the basis of clinical, pulmonary function tests (PFTs) and HRCT. PFTs and thoracic 18FDG-PET/CT were performed pre and post-treatment. Pulmonary FDG uptake (SUVmax) was calculated pre and post-treatment.

RESULTS

Changes in pulmonary SUVmax correlated with pulmonary function changes post-treatment (FEV1 r=-0.60, p=0.004; FVC r=-0.65, p=0.001; TLco r=-0.65, p=0.004). In addition, pretreatment SUVmax correlated with post treatment SUVmax (r= 0.51, p=0.019).

CONCLUSION

18FDG-PET/CT has potential as a biomarker in patients with DPLD with a mixed reticular ground-glass HRCT appearance

CLINICAL RELEVANCE/APPLICATION

18FDG PET/CT has potential to monitor treatment response in patients with NSIP

NMS177

The Use of Ga68-DOTATATE PET/CT for Diagnostic Assessment in Insulinomas  (Station #5)

Fuad Novruzov : Nothing to Disclose , James Patrick Connelly MBBS (Presenter): Nothing to Disclose , Jamil A Aliyev : Nothing to Disclose , Jamshed Bomanji : Nothing to Disclose , Ming Young Simon Wan MBBCChir : Nothing to Disclose , Rizwan Syed MBBS, FRCR : Nothing to Disclose , Irfan Akbar Kayani MRCP, FRCR : Nothing to Disclose

PURPOSE

68Ga-Dota-DPhe1, Tyr3-octreotate (68Ga-Dotatate) is a novel selective somatostatin analogue ligand which shows increased affinity for somatostatin receptor subtype 2 (SST2) and has been increasingly used for imaging neuroendocrine tumours with PET/CT. We investigated the utility of 68Ga-Dotatate positron emission tomography/computed tomography (PET/CT) in patients with benign and malignant insulinomas.

METHOD AND MATERIALS
We enrolled forty consecutive patients (17 men, 23 women), mean age of 47.3 (range: 8-83) who underwent 68Ga-Dotatate PET/CT on basis of a) suspected insulinoma (10/40), b) suspected recurrent insulinoma (15/40) and c) localisation of biochemically proven insulinoma (15/40). 68Ga-Dotatate PET/CT findings were correlated with final diagnosis and results of conventional imaging modalities (diagnostic CT and MRI).

RESULTS

In 40 patients 68Ga-Dotatate PET/CT was true positive in 20, true negative in 13, false negative in 5 and false positive in two. Overall sensitivity, specificity, PPV and NPV for 68Ga-Dotatate was 80%, 87%, 0.9 and 0.72. There was a significant difference (p=0.046) for detection of benign versus malignant insulinomas with 68Ga-Dotatate. The sensitivity, specificity, PPV and NPV of 68Ga-Dotatate for benign tumours was 64 %, 100 %, 1 and 0.5. The sensitivity, specificity, PPV and NPV of 68Ga-Dotatate for malignant tumours was 100%, 100%, 1, and 1. 68Ga-Dotatate PET/CT was able to localise insulinoma in 3 patients with false negative CT/MRI. In 1 patient insulinoma was positive with CT/MRI but false negative with 68Ga-Dotatate PET/CT. In 3 patients 68Ga-Dotatate PET/CT and CT/MRI were false negative for benign insulinomas.

CONCLUSION

68Ga-Dotatate PET/CT is useful to determine the presence of insulinoma. 68Ga-Dotatate has a higher sensitivity in patients with malignant versus benign tumours.

CLINICAL RELEVANCE/APPLICATION

68Ga-Dotatate is a novel selective somatostatin analogue ligand which shows increased affinity for somatostatin receptor subtype 2 (SST2) and has been increasingly used for imaging neuroendocrine tumours with PET/CT.
RESULTS

The perfusion parameters and 58 nodes diagnosed as metastasis or non-metastasis by histologic or imaging assessment were correlated. Twenty-six of them were metastatic and the remains were non-metastatic. BF, MTT, and PS of metastatic nodes showed significantly higher than those of non-metastatic nodes (p=0.005, 0.04, and 0.01, respectively). In univariate analysis, BF and PS showed significant association with metastatic nodes (p=0.006, and 0.02, respectively). In multivariate analysis, only BF was identified as a significant parameter associating with metastatic nodes (p=0.03). In receiver operating characteristic analysis, a feasible threshold value of BF for distinguishing metastatic nodes from non-metastatic nodes revealed a sensitivity of 76.2%, specificity of 72.5%, positive predictive value of 66.7%, and negative predictive value of 80.8%, respectively.

CONCLUSION

Adaptive 4D volume perfusion CT covering the whole-neck in patients with HNSCC may be useful for differentiation between metastatic and non-metastatic cervical lymph nodes.

CLINICAL RELEVANCE/APPLICATION

Adaptive 4D volume perfusion CT covering the whole-neck in head and neck squamous cell carcinoma patients may be useful for differentiation between metastatic and non-metastatic cervical lymph nodes.

NRS425

Thyroid Nodules Ultrasound Assessment with Semiquantitative, Quantitative and Qualitative Elastography: Comparison with Cytological Results (Station #2)

Athanasios N. Chalazonitis MD, MPH (Presenter): Nothing to Disclose , Zoi Antoniou BMedSc : Nothing to Disclose , Christina Gkali MD : Nothing to Disclose

PURPOSE

The purpose of our study is to evaluate the diagnostic accuracy of Semiquantitative, Quantitative and Qualitative Elastography, as an adjunctive technique to conventional ultrasonography comparing both imaging methods with cytological results.

METHOD AND MATERIALS

55 consenting patients with thyroid nodules meeting the ultrasonographic criteria for further testing with Fine Needle Aspiration (FNA), underwent both Strain Elastography (SE) and Acoustic Radiation Force Impulse (ARFI) imaging. SE provides qualitative assessment of the tissue hardness. Strain ratio consist a Semiquantitative type of Elastography. ARFI is divided into two types: a) Virtual Touch tissue Imaging (VTI) which provides the relative stiffness in qualitative way in the selected region of interest (ROI) on a gray scale image and b) Virtual Touch tissue Quantification (VTQ) which describes quantitatively the hardness of tissue. FNA was performed to all nodules and the results of the Elastography were compared to the cytological results.

RESULTS

Out of the 55 examined nodules, 51 with negative SE and ARFI elasticity proved to be benign. Out of the 4 remaining nodules, all had suspicious elastographic findings, 3 proved to be malignant (2 papillary carcinomas, 1 follicular carcinoma) and 1 proved to be benign.

CONCLUSION

Ultrasound Elastography is a relatively new and advanced clinical application, easily implemented, fast and reproducible. Combined Semiquantitative, Quantitative and Qualitative Estography as an adjunctive tool to conventional ultrasonography can improve the diagnostic accuracy and the sensitivity to malignant thyroid nodules.

CLINICAL RELEVANCE/APPLICATION

To evaluate the diagnostic accuracy of Semiquantitative, Quantitative and Qualitative Ultrasound Elastography in differentiating benign and malignant thyroid nodules.

NRS426

MR Imaging of Syrinxes: Is Contrast Always Necessary? (Station #3)

Vincent Maurice Timpone MD (Presenter): Nothing to Disclose , Sohil H. Patel MD : Nothing to Disclose

PURPOSE

The imaging work up of a syrinx often includes contrast enhanced MR imaging to exclude the presence of an underlying mass lesion. The diagnostic yield of obtaining these additional contrast enhanced sequences is not well defined in the literature. We hypothesized that non-contrast T2WI sequences alone could reliably exclude the presence of an underlying syrinx associated lesion, without the need for additional contrast imaging.
METHOD AND MATERIALS

We analyzed contrast enhanced MR scans of 87 consecutive patients with syringes over a 12 month period. The presence or absence of an associated spinal lesion was determined independently by 2 neuroradiologists using only sagittal and axial T2WI. Imaging features considered positive for a possible syrinx associated lesion on T2WI included cord signal abnormality separate from the syrinx, cord expansion, or complex syrinx septations/nodularity. Using contrast enhanced sequences as the reference standard, statistical analysis was subsequently performed to determine the accuracy of T2WI in detecting an associated spinal lesion.

RESULTS

Of the 87 patients, 49 were female and 38 male, with age range 2 - 77 years (median 43 years). Pathologies associated with the syringes included: 23 mass lesions, 11 Chiari malformations, 3 spinal cord contusions, and 50 idiopathic. Based on evaluation of each syrinx with T2WI alone, reader sensitivity for underlying mass lesion was 100%, specificity 83%, PPV 66%, NPV 100% (p<0.0001). Readers detected no findings suspicious for syrinx-associated mass lesion in 55/87 cases, and findings suspicious for mass lesion in 33/87 cases. Inter-reader agreement was excellent (kappa = 0.88).

CONCLUSION

Non-contrast MRI with sagittal and axial T2WI is an effective screening tool for the workup of a syrinx, and can reliably exclude the presence of an associated mass lesion. Post-contrast imaging may not be required in the majority of cases of spinal cord syrinx.

CLINICAL RELEVANCE/APPLICATION

In cases of syrinx, T2WI alone reliably excludes the presence of an underlying mass lesion. More judicious use of follow up contrast imaging may help save time and lower healthcare costs.

NRS427

Genetic Frontotemporal Dementia with TDP-43 Inclusions: Distinct Radiological Phenotypes between Patients with PGRN and C9ORF72 Mutations (Station #4)

Anne Bertrand MD, PhD (Presenter): Nothing to Disclose, Fatima Ameur MD : Nothing to Disclose, Paola Caroppo MD : Nothing to Disclose, Didier Dormont MD : Nothing to Disclose, Alexis Brice : Nothing to Disclose, Isabelle Le Ber : Nothing to Disclose, Olivier Colliot : Nothing to Disclose

PURPOSE

To study the MR phenotypes of the 2 most frequent genetic forms of frontotemporal dementia: PGRN and C9ORF72 mutations.

METHOD AND MATERIALS

2 readers retrospectively reviewed axial FLAIR and 3DT1 images of 27 patients with a genetic form of frontotemporal dementia: 17 patients with C9ORF72 mutation and 10 patient with PGRN mutation. The severity of FLAIR hyperintensity was rated using the Fazekas & Schmidt score. The type of FLAIR hyperintensities was rated using a 3-level score: A- vascular type; B- vascular type predominating in the areas of atrophy; C-non vascular type. The presence of regional atrophy was scored as follow: presence or absence of an anteroposterior gradient of atrophy; presence or absence of a left-to-right or right-to-left gradient of atrophy.

RESULTS

Interrater agreement was moderate for Fazekas & Schmidt score (0.50 {0.16-0.68}) and was high for the type of FLAIR intensities (0.79 {0.56-0.91}), the presence of anteroposterior gradient of atrophy (0.78 {0.61-1}) and the presence of left-to-right or right-to-left gradient of atrophy (0.73 {0.52-0.94}) (weighted kappa tests). Atypical FLAIR hyperintensities (type B-C) were present in 90% of patients with PGRN mutation, while only 12% with C9ORF72 mutation. Asymmetrical anterior atrophy, characteristic of frontotemporal dementia, was present in 70% of patients with PGRN mutation, while only 18% of patients with C9ORF72 mutation.

CONCLUSION

Major phenotypic differences distinguish on brain MRI C9ORF72 and PGRN mutations, which are both related to frontotemporal dementia with TDP-43 inclusions. This result demonstrates that gene-related effects can overpass lesion-related effects in the phenotypic expression of frontotemporal dementias.

CLINICAL RELEVANCE/APPLICATION

In patients presenting with frontotemporal dementia, neuroradiologists should raise the possibility of a genetic form linked to PGRN mutation when atrophy is particularly marked, and associated with atypical FLAIR hyperintensities, predominating in the areas of atrophy.

NRS428

Quantification of Multiple Sclerosis Normal-appearing White Matter on Quantitative Susceptibility Mapping (QSM) (Station #5)

Weiwei Chen (Presenter): Nothing to Disclose, Susan Gauthier : Nothing to Disclose, Chu Pan MD : Nothing to Disclose, Ketao Mu PhD : Nothing to Disclose, Tian Liu PhD : Nothing to Disclose, Yi Wang PhD : Nothing to Disclose, Wenzhen Zhu MD, PhD : Nothing to Disclose

PURPOSE

To quantify the susceptibility of normal appearing white matter (NAWM) by quantitative susceptibility mapping (QSM) to study its correlation with clinical features in MS patients.
METHOD AND MATERIALS
Seventy consecutive clinical confirmed RRMS patients (23M/47F, 40.6±10.6yrs, EDSS: 0-6; disease duration 0-43yrs) and 26 age and gender matched healthy controls (HCs) (9M/15F, aged:39.0±11.4yrs) were retrospectively selected. White matter regions without an abnormal signal on T2w, T1w, and T2FLAIR images were assumed to be NAWM for MS patients and normal white matter (NWM) for healthy controls. Region-of-interests (ROIs) of NAWM/NWM and CSF were drawn in bilateral frontal and parietal white matter, in the genu and splenium of the corpus callosum, and in the body of lateral ventricle manually by two neuroradiologists on T2-weighted images. The ROIs were overlaid onto QSM and NAWM/NWM susceptibility was calculated as its susceptibility difference from the corresponding patient/HC CSF susceptibility to eliminate possible constant offsets in susceptibility maps. The mean value of NAWM/NWM susceptibility was calculated for each patient. The significance of difference in NAWM/NWM susceptibility was assessed by t-test and One-Way ANOVA with Bonferroni adjustment.

RESULTS
A total of 511 NAWM ROIs were drawn in 70 MS patients and 208 NWM ROIs in 26 HCs. Of 70 MS patients, 15 patients had one or more Gadolium-enhanced MS lesions, the remaining 55 had no Gadolium-enhanced MS lesion. The NAWM of MS patients showed significantly higher susceptibility than NWM of HCs (-19.96 ± 8.29ppb vs. -28.56 ± 5.44ppb, p<0.001). However, the NAWM of patients with Gd-enhanced lesions showed a similar susceptibility to healthy controls NWM (-25.97 ± 6.19ppb vs. -28.56 ± 5.44ppb, p=0.802), while the NAWM of MS patients without Gd-enhanced lesions showed significantly higher susceptibility than both healthy controls NWM (-18.29 ± 8.06ppb vs. -25.97 ± 6.19ppb, p<0.001) and the NAWM of patients with Gd-enhanced lesions (-18.29 ± 8.06ppb vs. -25.97 ± 6.19ppb, p=0.001) (figure 1).

CONCLUSION
The susceptibility of NAWM increased in MS patient compared to HCs. However, the susceptibility of NAWM increased only in patient without Gadolium-enhanced lesions, while closed to that of HCs in patient with Gadolium-enhanced lesions.

CLINICAL RELEVANCE/APPLICATION
QSM enable quantify the susceptibility of NAWM in MS patient, which might contribute to better understanding of MS pathogenesis.

NRS429
Double Inversion Recovery Imaging of the Brain in Seizures (Station #6)
Raja Sekaran Kattumannarkudi Ramalingam MBBS (Presenter): Nothing to Disclose, Sravanthi Mantripragada MBBS : Nothing to Disclose, yvette kirubha MBBS, MD : Nothing to Disclose, Meera krishnakumar : Nothing to Disclose, Chidambaranathan Natesan MD, PhD : Nothing to Disclose
PURPOSE
To evaluate the utility of Double inversion recovery(DIR) imaging of brain in comparision to Fluid attenuated inversion recovery (FLAIR) in patients with seizures by analysing the lesion detection, lesion conspicuity and additional diagnostic informations

METHOD AND MATERIALS
This prospective study was conducted with institional review board approval and informed consent was obtained. The study protocol ( Routine epilepsy protocol+ DIR sequence) was performed with a 1.5 Tesla MRI in 123 consecutive seizure patients (mean age 18.2 years; range, 3 months-72 years) and 34 control population. Two radiologists independently assessed three criteria: lesion detection, conspicuity and additional diagnostic informations by using three point grading system, and compared FLAIR and DIR images. Interobserver agreement of each criteria were compared using kappa statistics.

RESULTS
On DIR images lesions were more conspicuous than FLAIR (p< 0.0001 & kappa 0.85 -Perfect agreement). Overall ability for the presence of lesions and detectability(p

CONCLUSION
DIR overcame the disadvantages of FLAIR in malformations of cortical development and hippocampal sclerosis.DIR images significantly improved the conspicuity of the lesions when compared to FLAIR especially lesions with low contrast on FLAIR images, lesions along the ependymal lining, cortical volume loss, abnormal cortical morphology,ectopic grey matter, pattern of abnormal gyri and sulci.DIR sequence can provide useful additional diagnostic information when evaluating cortical dysplasias, hippocampal sclerosis, lesions with perilesional edema, cortical atrophy.

CLINICAL RELEVANCE/APPLICATION
DIR sequence should be used as an adjunctive to FLAIR sequence in evaluation of epileptogenic lesions but need not replace it and it is recommended to implement DIR sequence in routine practice.

NRS430
Association of Hyperdense Middle Cerebral Artery Sign with Clinical Outcomes and Recanalization Rates in Patients with Acute Ischemic Stroke Treated with Intra-arterial Procedures (Station #7)
Irene Martin Lores MRCS (Presenter): Nothing to Disclose, Manuel M. Moreu MD : Nothing to Disclose, Carlos I Gomez-Escalonilla : Nothing to Disclose, Juan Arrazola : Nothing to Disclose, Luis Lopez Ibor : Nothing to Disclose
PURPOSE
To study the relationship between the hyperdense middle cerebral artery sign with the clinical outcome at three months and the recanalization rate after an intra-arterial procedure in patients with acute ischemic stroke.

**METHOD AND MATERIALS**

A retrospective cohort study was made with all patients with an anterior ischemic stroke attended in our department during 2008-2013. All of them went through an endovascular procedure. They were divided in two groups using a non-contrast CT, based on the hyperdense vessel sign (defined as an hyperdense vessel diagnosed by two independent observers using a 35/35 window levels and comparing with contralateral vessel). Recanalisation rate was determined with the last image of the intra-arterial procedure by two independent observers and graded using TICI scale. A neurologist based on modified Rankin scale, 90 days after the stroke, defined clinical outcome.

**RESULTS**

94 patients were evaluated with a mean age of 64,6 years old, 48 patients (51,1%) where women and 46 (48,9%) men. Median NIHSS was 19. Intra-arterial procedure was made with stent retrievers in almost all of the patients (93,6%). Hyperdense vessel sign was described in 55 patients. Good outcomes where identified in 37 patients and 3 month mortality was17%. Statistic analysis was made using SPSS 20. Bad neurological outcome was more probable with an hyperdense vessel sign at 90 days (p=0,004) and at 7 days(p=0,002). Recanalization was harder in patients with hyperdense vessel sign (p=0,009).

**CONCLUSION**

In patients where mechanical thrombectomy is an option hyperdense vessel sign have worse clinical outcomes and implies lower recanalization rates.

**CLINICAL RELEVANCE/APPLICATION**

Although the results after the revascularization therapy are worse in patients with hyperdense vessel than in patients without this sign, it is still better than leaving the vessel closed. Therefore we recommend for these patients the use of intraarterial devices with better index results.
Anatomical based review of intractable epilepsy
a. Hippocampus (i.e. mesial temporal sclerosis, encephalitis)
b. Cortex: (i.e. focal cortical dysplasia, encephalotrigeminal angiomatosis)
c. Periventricular: (i.e. heterotopia, subependymal nodules in tuberous sclerosis)
d. Miscellaneous: (i.e. epileptogenic tumors, cavernous hemangioma)

Post quiz
The purpose of this exhibit is: 1. To share background knowledge about DWI of the head and neck 2. To review MR findings of variable head and neck cancers, including DWI

TABLE OF CONTENTS/OUTLINE

- Brief review on head and neck MR imaging
  : Anatomic considerations related to imaging in the head and neck region
  : Principle of DWI and its clinical value in head and neck cancers
- Review of image findings in head and neck of actual cases
  : Variable malignant lesions in head and neck
    SCC (tonsil, hypopharynx, larynx)
    Lymphoma
    Metastatic LNs
    Uncommon malignancy
    Post-treatment changes - recurrence or post OP change
  : Other malignant mimics and pitfalls, especially on DWI
- Summary and future directions

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**OBE-TUB**

**Obstetrics/Gynecology Tuesday Poster Discussions**

*Education Exhibits*

**OB**

AMa PRA Category 1 Credits™: .50

Tue, Dec 2 12:45 PM - 1:15 PM   Location: OB Community, Learning Center

**PDS-TUB**

**Pediatric Tuesday Poster Discussions**

*Scientific Posters*

**PD**

AMa PRA Category 1 Credits™: .50

Tue, Dec 2 12:45 PM - 1:15 PM   Location: S101B

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**Sub-Events**

**PDS238**

**Description of a Novel Approach for TIPS Placement in the Pediatric Patient: The Constrained TIPS Technique (Station #1)**

Brandon C. Perry MD (Presenter):  Nothing to Disclose , Jeffrey Scott Pollak MD :  Nothing to Disclose , Giri Shivaram MD :  Nothing to Disclose

**PURPOSE**

Transjugular intrahepatic portosystemic shunt (TIPS) placement is indicated in pediatric patients to manage bleeding and other complications of portal hypertension, with similar rates of technical success, clinical outcomes, and complications as in adults. However, given pediatric patients’ smaller anatomy and potential growth, a fixed shunt diameter is suboptimal. We describe a novel technique for pediatric TIPS using concentric placement of an outer, bare metal balloon expandable stent and inner, ePTFE endograft. This system creates an intentional stenosis of the shunt at initial placement that can be dilated at a later time to accommodate growth of the patient or hemodynamic changes.

**METHOD AND MATERIALS**

A modified TIPS technique was performed on two patients in February and March 2014. Patient 1 (6 year-old female) presented with massive gastric variceal bleeding secondary to portal hypertension from biliary atresia, which was unable to be controlled endoscopically. Patient 2 (15 year-old female) presented with recurrent portal and mesenteric vein thrombosis following splenectomy for idiopathic thrombocytopenic purpura. In both patients, a 6 mm x 27 mm Express LD balloon expandable stent was placed in the hepatic parenchymal tract of the TIPS to constrain a 10 mm diameter VIATORR stent. In patient 1, the constrained segment of the shunt was increased to 8 mm at the time of the initial procedure because of insufficient decompression and in patient 2 the constrained segment was left at 6 mm.

**RESULTS**

Technical success was achieved in both cases. In each case, the portosystemic gradient was reduced below 12 mmHg. This resulted in control of life-threatening variceal bleeding in Patient 1. She subsequently underwent liver transplant 3 days following TIPS placement. Patient 2 underwent successful catheter-directed thrombolysis through the TIPS to treat portal and mesenteric venous thrombosis.

**CONCLUSION**

TIPS can be created in children with the use of ePTFE endografts constrained by balloon expandable stents. This allows for more precise calibration of shunt diameter and allows for future increase in shunt diameter as
necessary to accommodate patient growth or change in hemodynamics.

**CLINICAL RELEVANCE/APPLICATION**

TIPS placement in children can be challenging due to smaller anatomy and considerations regarding future growth. The constrained TIPS technique is safe and may be particularly useful in the pediatric patient.

**PDS239**

**Initial Experience with Metal Artifact Reduction (MAR) Algorithm on C-arm CT Images Acquired during Pediatric Bone Biopsy Procedures (Station #2)**

Sphoorti Shellikeri (Presenter): Research funded, Siemens AG; Erin Girard PhD: Employee, Siemens Corporation; Anne Marie Cahill MBCh: Nothing to Disclose

**PURPOSE**

Metallic objects in interventional procedures can induce artifacts in C-arm CT images, reducing the image quality and potentially affecting diagnostic decisions. The purpose of this study is to evaluate the efficacy of a Metal Artifact Reduction (MAR) algorithm in reducing metal artifacts in C-arm CT images acquired during pediatric bone biopsy procedures.

**METHOD AND MATERIALS**

C-arm CT images (syngo DynaCT, Artis Zee VC14, Siemens AG, Forchheim, Germany) were acquired during 8 bone biopsy procedures using an 8s-DR low dose protocol (0.1/0.17 µGy/p entrance dose). Two C-arm CT images of the biopsy needle were also acquired in an anthropomorphic torso phantom. All images were reconstructed offline on a clinical workstation (syngo XWP, VB15D) and corrected on a research workstation using the MAR prototype. The uncorrected and corrected images were qualitatively assessed by 2 readers of varying experience using a 3-point Likert scale (2: no/minimal artifact; 1: moderate artifact; 0: massive artifact). Additionally, the images were assessed quantitatively using mean and standard deviation, in Hounsfield unit, measured in 6 regions of interest in each data set (4 ROI’s surrounding the needle and 2 distant from the needle).

**RESULTS**

8/10 images corrected using MAR algorithm scored a 2 on the Likert scale, suggesting an improvement in the image quality with no/minimal artifacts and a very good needle and soft tissue visualization. There was no change in image quality for 2/10 images which already had no/minimal artifacts.

The MAR algorithm showed significant reduction in metal artifacts in regions surrounding the needle with noise reduction up to 177.25 HU (avg. reduction of 89.41 HU) in the patient group, and up to 289 HU (avg. reduction of 135.88 HU) in the phantom group. In tissue and air regions distant from the needle, noise level remained relatively unchanged (up to 7.5 HU noise reduction in the patient group and 2.5 HU noise increase in the phantom group).

**CONCLUSION**

Our initial experience with this C-arm CT MAR algorithm shows significant reduction in metal artifacts and improved image quality around the needle and the soft tissue in C-arm CT images acquired during pediatric bone biopsy procedures.

**CLINICAL RELEVANCE/APPLICATION**

The MAR algorithm can be used to reduce metal artifacts in C-arm CT images, acquired during interventional pediatric bone biopsy procedures, for better visualization of the needle and soft tissue.

**PDS240**

**Percutaneous Radiologic Gastrostomy in a Pediatric Population: A Modified Chiba-needle Puncture Technique with Single Gastropexy (Station #3)**

Jung-Hoon Park MS, RT (Presenter): Nothing to Disclose; Ho-Young Song MD: Nothing to Disclose; Ji Hoon Shin MD: Nothing to Disclose; Jin Hyong Kim MD: Nothing to Disclose; Jong Kun Jang: Nothing to Disclose; Wei-Zhong Zhou: Nothing to Disclose; Young Chul Cho BS: Nothing to Disclose

**PURPOSE**

Purpose of this retrospective study was to evaluate the technical feasibility and clinical effectiveness of percutaneous radiologic gastrostomy (PRG) using a modified Chiba-needle puncture technique with single gastropexy in pediatric patients.

**METHOD AND MATERIALS**

From July 2006 to December 2013, PRG was performed in 12 children (median age, 21 months; range, 6 - 46 months) using fluoroscopic guidance. Their stomachs were punctured using a 21-gauge Chiba needle. A single anchor was used for gastropexy through 6Fr Neff catheter, and a tube was inserted through the same tract of the anchor using a 12-14 Fr pigtail catheter. We then evaluated the technical success of the procedure, the number of puncture attempts using a 21-gauge Chiba-needle, the procedure time, complications, and treatment of complications.

**RESULTS**

PRG was technically successful in all patients. A single puncture attempt was all that was required in 10 patients...
Two attempts were needed in two patients (17%). The average procedure time was 10 min, 25 s (range 5 min, 5 s - 25 min, 24 s). Pneumoperitoneum requiring tube change occurred in two of the 12 patients (17%). Two patients experienced pain immediately following the procedure. Three patients who showed an esophagogastric reflux after PRG underwent conversion percutaneous radiologic gastrojejunostomy (PRGJ).

CONCLUSION

PRG using a modified Chiba needle technique with single gastropexy is technically feasible and clinically effective. All complications are managed by minimally invasive or conservative techniques. PRGJ can be considered as an alternative option in patients with a high risk of aspiration pneumonia resulting from esophagogastric reflux.

CLINICAL RELEVANCE/APPLICATION

PRG using the Chiba-needle puncture technique and with the use of single gastropexy was technically feasible, and we were able to achieve 100% technical success.

PDS241

Influence of Increased Weight and Blood Pressure in Prepubertal Children Related to the Carotid Artery Intima-media Complex Thickness (Station #4)

Arine Santos Pecanha MD : Nothing to Disclose, Alexandra Monteiro MD, PhD (Presenter): Nothing to Disclose, Fernanda Gazolla : Nothing to Disclose, Isabel R Madeira : Nothing to Disclose, Maria Alice N Bordallo : Nothing to Disclose, Cecilia N Miranda : Nothing to Disclose, Nadia C P Rodrigues : Nothing to Disclose

PURPOSE

Childhood obesity is a public health problem and its consequences on the vascular endothelium may be measured by ultrasound. This study intends to evaluate the behavior of the intima-media thickness comparing eutrophic, overweight and obese children.

METHOD AND MATERIALS

Carotid ultrasound was performed in 129 prepubertal children of about 7.7 (5-10) years old, 80 of them obese, 18 overweight and 31 eutrophic, all without comorbidities and classified by body mass index Z-score (BMIZ). The measurements were performed manually by two independent observers, with at least three measurements in the common carotid artery (CIMT Right) and the left common carotid artery (CIMT Left), in the plane located about 2.0 cm below the bifurcation. Blood pressure (BP) was also measured.

RESULTS

The median CIMT Right was 0.040 in eutrophic children, in that of overweight, 0.045, and 0.050mm (p-value 0.35) in the obese ones. Concerning the CIMT Left, it was respectively 0.040, 0.047 and 0.050mm (p-value 0.03). The mean CIMT Right and Left was 0.045, 0045 and 0050 successively in the three groups (p-value 0.07). In bivariate logistic regression analysis, there was a positive association, with statistical significance of BMI index-Z and systolic BP with the average thickness of the carotid intima (BMI Thick trace) of the left and right sides, and of the average values of both. Diastolic BP was positively associated with statistical significance with left BMI Thick trace and the average of the values of the left and right sides. In multivariate analysis, a positive association with statistical significance of BMI Z-index and systolic BP with left BMI Thick trace was verified. The systolic BP was associated positively and with statistically significance with BMI Thick trace to the average of the values of both left and right sides.

CONCLUSION

The increased weight in children directly affects the intima-media complex thickness, although it is only statistically positive in the left carotid artery. The systolic blood pressure levels were positively associated with thickening of the carotid intima-media left, and to the average of the values of intima-media thickness of the left and right carotid arteries.

CLINICAL RELEVANCE/APPLICATION

The pathogenesis found in most cardiovascular disease is atherosclerosis, which begins in childhood, and the thickening of the carotid intima-media determined by ultrasonography is excellent marker.

PDS242

Effectiveness of Diffusion Weighted Imaging in Evaluation of Intra-abdominal Abscesses in Children (Station #5)

Nishard Abdeen MD (Presenter): Nothing to Disclose, Khaldoun Koujok MD : Nothing to Disclose, Pablo Caro MD : Nothing to Disclose, Rhys Abdeen Abdeen : Nothing to Disclose

PURPOSE

Intra-abdominal abscesses in children are often imaged with contrast enhanced CT, and there are few data regarding MRI appearance. MRI offers superior contrast resolution without ionizing radiation, which is an important consideration in children. The purpose of this study is to describe the appearance of abscesses on MRI, particularly diffusion weighted imaging, with particular reference to distinguishing abscess from bowel loops using ADC values.

METHOD AND MATERIALS

Twenty five intra-abdominal abscesses in twenty two children were retrospectively evaluated with axial DWI, axial and coronal T2 weighted SSFSE, and sagittal T2 weighted images with fat saturation. The abscess region showing the most restricted diffusion on ADC map was measured using a circular region of interest of 0.3 mm². ADC in an adjacent bowel loop and in the bladder was also recorded. Four observers (three pediatric
radiologists and one pediatric radiology fellow) performed the same measurements on all abscesses. Interobserver variation was assessed using 95% Bland Altman limits and intraclass correlation coefficients.

RESULTS
The mean ADC was significantly decreased (p < 0.05, student t test) in all abscesses relative to adjacent bowel loops for all observers as follows, with mean values of 0. 715 +/-0.083, 0.727+/-0.087, 0.756+/- 0.048, and 784+/-0.067 (x10-3 mm2/s) compared to mean values for adjacent bowel loops which were 3.256+/0.079, 3.286+/0.095, 3.131+/0.098 and 3.185+/0.106(x 10 -3 mm2/s) respectively. The mean ADC for bowel loop contents was similar to that of urine ADC for all observers at 3.444+/-.021, 3.327+/-.021, 3.435+/-.169, 3.386+/-.107 (x 10 -3 mm2/s) respectively. There was good interobserver agreement with 95% limits of agreement between readers varying between 17 and 22% of the mean.

CONCLUSION
Diffusion weighted imaging is effective at distinguishing abscesses which show restricted diffusion (arrow in figure) from bowel loops or bladder (b in figure) which do not. Mean ADC in abscesses is significantly lower than in bowel loops. The ADC in bowel loops adjacent to the abscess are similar to that of free fluid (urine).

CLINICAL RELEVANCE/APPLICATION
Diffusion weighted MRI can distinguish abscess from adjacent bowel loops in children, without ionizing radiation or intravenous contrast.
To evaluate the potential of a new ultrasound (US) based 3D Hydronephrosis Index (HI) to assess the severity of hydronephrosis from the semi-automatic quantification of renal parenchyma (P) and collecting system (CS).

METHOD AND MATERIALS

The retrospective dataset (IRB approved) consists of 10 patients (0-7 years) whose severity varies from grade 1 to 3 according to the Society for Fetal Urology hydronephrosis scale (SFU-HS). 3DUS images were acquired from an iU22 system with a X6-1xMatrix transducer (Philips Healthcare). The kidney (K) was segmented using semi-automated active shape models, including new shape and texture models tailored to US physics. The CS was obtained with a new extension of 3D graph cuts that includes brightness and contrast normalization, and anatomical prior information. K and CS were delineated manually by a board certified radiologist to evaluate the accuracy through volume overlap (VO), relative volume difference (RVD) and average surface distance (ASD) (leave-one-out cross-validation). A 2D slice containing a longitudinal section of the K and its CS was manually segmented to compute the 2DHI. Finally, we analyze the Spearman correlation of both 3DHI and 2DHI to the SFU-HS.

RESULTS

For the segmentation of the K and CS, VO was 86% and 62%, RVD was 3% and 26%, and ASD was 3.06mm and 0.35mm, respectively. The error in the estimation of the 3DHI was 1.5 percentage points. For the groups with SFU-HS 1, 2, and 3, the average (and range) 3DHI was 0.83 (0.82-0.83), 0.71 (0.56-0.80) and 0.43 (0.35-0.48), respectively. The values for the 2DHI were 0.80 (0.73-0.83), 0.62 (0.55-0.66) and 0.49 (0.35-0.64) for SFU-HS 1, 2, and 3 respectively. The correlation coefficient between the HI and the SFU-HS was 0.92 (3DHI) and 0.82 (2DHI).

CONCLUSION

The quantification of 3DUS images shows the potential of 3DHI for the assessment of severity of hydronephrosis with better agreement with the SFU-HS than the classic 2DHI. Further studies will focus on developing rigorous correlations with more detailed functional parameters.

CLINICAL RELEVANCE/APPLICATION

Automated analysis of 3D kidney US data demonstrates higher correlation with SFU-HS than manual 2D measures, demonstrating the potential for 3D US image processing techniques.

PHS162
Reduction of Coronary Motion Artifacts by a Novel Motion Correction Algorithm in Coronary CT Angiography for Patients with Different Heart Rates (Station #1)

Rika Fukui (Presenter): Nothing to Disclose, Takuma Shuto: Nothing to Disclose, Isao Tanaka: Nothing to Disclose, Yun Shen PhD: Employee, General Electric Company Reseacher, General Electric Company, Haruhiko Machida MD: Nothing to Disclose, Elko Ueno MD: Nothing to Disclose, Xiao Zhu Lin MD: Nothing to Disclose, He Qing Wang MSc: Nothing to Disclose

PURPOSE

To retrospectively investigate reduction of coronary motion artifacts by a novel motion correction algorithm (MCA) in coronary CT angiography (CCTA) for patients with different heart rates (HRs).

METHOD AND MATERIALS

We divided 60 patients who underwent CCTA into 4 groups based on their average HRs as follows: 1) average HR ≤ 59 bpm, 13 patients; 2) 60-69 bpm, 24; 3) 70-79 bpm, 19; 4) ≥ 80 bpm, 4. Two readers, in consensus, evaluated quality of axial images of the left main trunk (the segment 5), anterior descending artery (LAD, the segment 6-8), circumflex artery (LCX, the segment 11, 13), and right coronary artery (RCA, the segment 1-3) reconstructed with and without the MCA at 40% (systole) and 75% of the R-R interval (diastole) using half-scan method. For each different HR group and cardiac phase, per-segment image quality regarding motion artifacts was visually graded using a 5-point scale and compared using Wilcoxon signed rank test, and percentage of per-vessel interpretable image quality (scores, 3-5) with MCA was calculated.

RESULTS

Averaged per-segment image quality score with MCA at the diastole was 4.7 ± 0.6, 4.5 ± 0.7, 3.8 ± 1.0, and
3.2 ± 0.9 for group 1, 2, 3, and 4, respectively; at the systole, 3.0 ± 0.8, 3.5 ± 1.0, 3.8 ± 0.8, and 3.8 ± 0.8; without MCA at the diastole, 4.3 ± 0.9, 4.0 ± 0.9, 3.1 ± 1.2, and 2.5 ± 0.9; at the systole, 2.2 ± 0.9, 2.6 ± 1.1, 3.0 ± 1.0, and 2.8 ± 0.9. For all the groups, the score was significantly better with MCA than without MCA at both the diastole and systole (P < 0.05). With MCA, percentages of per-vessel interpretable image quality at the diastole for the LAD was 100, 99, 99, and 88% for group 1, 2, 3, and 4, respectively; for the LCX, 100, 100, 90, and 75%; for the RCA, 95, 97, 77, and 75%; at the systole for the LAD, 50, 81, 92, and 100%; for the LCX, 50, 92, 87, and 75%; for the RCA, 100, 72, 91, and 83%.

CONCLUSION

Use of MCA significantly reduced coronary motion artifacts and per-vessel interpretable image quality of ≥ 95% even if reconstructed only at 75% of the R-R interval for patients with average HR ≤ 69 bpm.

CLINICAL RELEVANCE/APPLICATION

Use of a novel MCA can reduce coronary motion artifacts, improve diagnostic accuracy, and increase the indication of step-and-shoot scan to reasonably reduce radiation dose in CCTA.

Development of Super High Resolution Computed Tomography for Extremities: Preliminary Study Using a Phantom Rotation Mechanism (Station #2)

Yuichi Murasaki (Presenter): Nothing to Disclose, Katsuhiro Ichikawa PhD: Nothing to Disclose, Shota Ito: Nothing to Disclose, Nagaso Daisuke: Nothing to Disclose

PURPOSE

Current multi-detector row computed tomography (MDCT) systems have sufficient temporal resolutions which enable cardiac scans, and however do not have sufficient spatial resolutions to visualize fine anatomical structures such as trabecular bones because of their detector pitches of approximately 0.5 mm. This study aimed to investigate the possibility of super high resolution CT for extremities with a significantly higher resolution than current MDCT systems.

METHOD AND MATERIALS

A flat panel detector system with a 0.148-mm detector pitch for general x-ray imaging (Luminous dRF, Siemens) and a handmade phantom rotation mechanism comprising a stepper motor with a minimum degree step of 0.15 were employed. Projection data of an Alderson foot phantom were acquired by fan x-ray beams with a 20-mm width narrow z-collimation and exposure parameters of 70 kV and 2 mAs. 300 projections were acquired with a rotation step of 1.2°. To reduce the geometrical blurring as possible, a long geometry (source-detector distance = 1500 mm) with a minimal available distance between the phantom and the detector surface was used. CT images were reconstructed by using a filter back projection algorithm. The CT images were compared with images obtained by a MDCT system, Siemens Somatom-Emotion (Emotion) using its highest resolution mode. The resolution property was evaluated using a 0.1-mm thin metal wire phantom.

RESULTS

The trabecular bones in the foot phantom were clearly visualized by the developed system, while Emotion could not visualize them. The 10% modulation transfer function was 3.0 cycles/mm with a normal reconstruction kernel, and this was significantly higher than that of Emotion (1.5 cycles/mm). Streak artifacts appeared in the image due to the insufficient projection number. Estimated CT dose index value was approximately 10 mGy.

CONCLUSION

The potential possibility of the super high resolution CT for extremities was demonstrated through the preliminary study using a general x-ray system and a phantom rotation mechanism. Further investigations for reducing the dose and artifacts was desired. Further investigations for reducing the dose and artifacts are required.

CLINICAL RELEVANCE/APPLICATION

If this super high resolution CT will be realized, this system might contribute to diagnosis of diseases with fine anatomical changes (e.g. early rheumatoid cartilage destruction and early structural change of trabecular bone in osteoporosis).

Evaluation of Radiation Dose to the Conceptus in Prophylactic Uterine Arterial Embolization (Station #3)

Mauro Campoleoni BS (Presenter): Nothing to Disclose, Antonio Nicolini MD: Nothing to Disclose, Irene Fulgheri: Nothing to Disclose, Andrea Avagliano: Nothing to Disclose, Cristian Bonelli: Nothing to Disclose

CONCLUSION

The procedure is safe. The two methods used for dose evaluation give similar results. When the use of fluoroscopy is optimized, fetal dose can be contained to a minimum, taking care, particularly, of a correct positioning (patient far from the tube and close to the detector) careful collimation, the use of a well filtered X-ray beam and the lowest possible pulse rate.
Background

Placental developmental abnormalities are among the worst post partum complications and can lead to severe hemorrhages, emergency hysterectomy and to several disorders like disseminated intravascular coagulation (DIC). In recent years, prophylactic uterine arterial embolization (UAE) has been proposed in order to reduce hemorrhagic risks. Up to now, this technique has not been clearly coded, and can include a fluoroscopy guided bilateral positioning of catheters in both the uterine arteries before the cesarean section, and this exposes the fetus to a certain amount of radiation dose. The purpose of this study was to evaluate the absorbed dose to the fetus for patients undergoing fluoroscopy imaging during this prophylactic catheterization, according to a specific protocol, and study optimized exposure parameters.

Evaluation

The procedure was successfully conducted on 10 patients with a gestational age (GA) higher than 34 weeks, 8 with placenta previa and 2 with placenta accreta. Two different methods were used to evaluate fetal doses: -measurements of Entrance Skin Dose (ESD) with thermoluminescent dosimeters at skin entrance in the X-ray field, applying then conversion factors from ESD to the average uterus dose; -calculation of ESD from a basic physical data (Dose Area Product, DAP and Source to Skin Distance, SSD) applying then a validated model (software FetDose v.4). A few simulations were made to better measure dose rates according to the pulse rate used.

Discussion

The average fluoroscopy time was 20 s (13 - 27), the mean DAP 93.9 cGy*cm2 (64 - 123), the mean Entrance Skin Dose 10.4 mGy (7.5 - 15.1). The average fetal doses resulted in 2.58 mGy (0.9-4.53) and 1.98 mGy (1.01 - 2.96) according to the two different methods respectively.

PSH165 Evaluation of Dose Delivery Accuracy in Leaf Motion Calculator Algorithms for Sliding Window IMRT (Station #4)

Lili Wu MS (Presenter): Nothing to Disclose, Hong Chen BS: Nothing to Disclose, Jiayang Lu MS: Nothing to Disclose, Blake Rowedder PhD: Nothing to Disclose, Yu Kuang PhD: Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The dose delivery accuracy of IMRT is primarily dependent on how well the leaf motion pattern calculated by the leaf motion calculator (LMC) algorithm matches the optimized field fluence map with MLC constraints. The Smart LMC (SLMC) in Eclipse treatment planning system is an advanced fluence delivery modeling algorithm as it takes into account fine MLC features including inter-leaf leakage, rounded leaf tips, non-uniform leaf thickness, and the spine cavity etc. In this study, SLMC and traditional Varian leaf motion calculator (VLMC) algorithms were investigated, for the first time, in dose delivery accuracy of sliding window (SW) IMRT using three patient specific quality assurance (QA) tools

Materials/Methods: The SW IMRT plans of 51 cancer cases (including 10 nasopharynges, 10 esophaguses, 9 breasts, 12 lungs, and 10 cervices) were included to evaluate dose delivery accuracy from leaf motion calculated by SLMC and VLMC. The leaf trajectories of each plan were derived from the same optimal fluence map by SLMC and VLMC, respectively. All plans were delivered using a Varian TrueBeam linear accelerator. Three-dimensional (3D) bi-planar diode array Delta4 and portal dosimetry from a high resolution 2D array electronic portal imaging device (EPID) were used to measure the delivered dose distribution. Independent dose calculation software IMSure was also used to verify the dose distribution. Gamma index was employed to compare the planned dose distribution calculated by both LMC algorithms and delivered dose distribution with the criteria of 3%/3mm and 2%/2mm. The MUs was also analyzed

Results: Gamma analysis shows an excellent agreement between the planned dose distribution calculated by both LMC algorithms and delivered dose distribution measured by three QA tools in all plans at 3%/3 mm, leading to a mean passing rate exceeding 97%. The IMSure calculation results show that the mean fraction of pixels with gamma < 1 was 97.0% ± 1.9% for SLMC and 98.9% ± 0.8% for VLMC. The Delta4 measurement results are in line with those of IMSure calculation. However, with the highest spatial resolution, EPID portal dosimetry demonstrates that gamma passing rate of SLMC was slightly higher than that of VLMC. The complex cases such as nasopharynx and cervical plans had the lowest gamma passing rate in the IMSure results, but showed a highest passing rate in portal dosimetry. Significant differences in the MUs were observed between these two LMCs (p < 0.001).

Conclusions: The study suggests that SLMC is modestly more accurate than VLMC in modeling advanced MLC features, which may lead to a more accurate dose delivery in SW IMRT. Current clinical tools might not be specific enough to differentiate the dosimetric discrepancies at the millimeter level calculated by these two LMC algorithms and complex cases.

PSH166 A Degradation of Diagnostic Image Quality in Musculoskeletal CT Imaging: Loss of Image Sharpness in CT Bone Imaging due to Positioning within the Scan Field of View - Causes and Several Possible Solutions (Station #5)

Frank N. Ranallo PhD (Presenter): Grant, General Electric Company, Ken L. Schreibman PhD, MD: Nothing to Disclose, Timothy Peter Szczykutowicz PhD: Equipment support, General Electric Company Research Grant, Siemens AG

CONCLUSION

When preservation of bone detail is important one must not only use the proper bone reconstruction algorithm, but also must keep the body part as close to the center of the SFOV as possible. Though this may be difficult with some imaging tasks, such as imaging of the shoulder and elbow, every effort should be made to this end. For the best resolution, the RFOV should also be kept small, ideally to 20 cm or less. Technologists and radiologists must be aware of the loss of resolution that occurs in bone imaging away from the center of the SFOV. This can be particularly detrimental in bone imaging of the shoulder and elbow. When possible on the scanner, a higher resolution mode utilizing focal spot deflection should be used if high resolution imaging is required away from the scanner iso-center.

Background

Both the positioning of an object in the scan field of view (SFOV) and the size of the reconstructed field of view (RFOV) can significantly affect and degrade the image sharpness and result images that can miss important pathology. This problem can be improved in several ways.
PHS167  Survey of Thoracic CT Protocols and Technical Parameters in Korean Hospitals: Tendency of CT Protocol Change before and after Establishment of Thoracic CT Guidelines by Korean Society of Thoracic Radiology (KSTR) (Station #6)

Ji-Won Kang MD (Presenter): Nothing to Disclose, Kyung-Hyun Do MD: Nothing to Disclose, Kichang Han MD: Nothing to Disclose, Eun Jin Chae MD, PhD : Nothing to Disclose, Dong Hyun Yang MD: Nothing to Disclose, Choon Wook Lee MD: Nothing to Disclose

PURPOSE
To analyze tendency of CT protocol changes and dose reduction from 2007 to 2012, after establishment of thoracic CT guidelines in 2008.

METHOD AND MATERIALS
We retrospectively reviewed CT scans from nationwide hospitals; one group from 2007-05-01 to 2007-05-31 and the other group from 2012-01-01 to 2012-01-31. A total of 100 CT scans from 2007 and 173 CT scans from 2012 were included by selecting only one CT scan from each hospital. In addition, each group was divided into two subgroups (A and B) by the level of hospitals; “A” subgroup from primary care hospitals and “B” subgroup from secondary and tertiary care hospitals. We obtained patient information, CT scan protocols, and CT dose parameters. Two radiologists analyzed the image quality and scan range according to thoracic CT guidelines.

RESULTS
When comparing the data from 2007 and 2012, tube current significantly decreased from 179.1 mean mAs to 137.2 mean mAs. Tube voltage decreased from 121.8 kVp to 120.5 kVp, which was not statistically significant. There were no significant changes in thickness and phase, either. Scan interval decreased from 6.4 mm to 4.8 mm. Insufficient scan range decreased from 19.0 % to 8.7 %. Suboptimal quality scans decreased from 33.0 % to 5.2 %. No significant change in excessive scan range was seen. Between group A and B, group B has lower tube voltage, smaller scan thickness and smaller scan interval both in 2007 and 2012. Group B has more phases in 2012, when compared to group A. In group A, insufficient scan range, which was prevalent in 2007, was statistically reduced in 2012. In group B, excessive scan range, which was 57.8% in 2007, remains to be as high as 46.4% in 2012. In terms of suboptimal quality scan, a significant decrease was seen in both groups.

CONCLUSION
During 5-year period from 2007 to 2012, a reduction in mAs can be interpreted as a decrease in radiation doses. Despite a lower radiation dose, the overall image quality was improved. We assume that these changes are attributed to the introduction of thoracic CT guidelines in 2008. However, excessive scan range and suboptimal quality scan still exist as CT protocols vary from hospital to hospital. In that sense, continuous education and dissemination of the guidelines are critical.

CLINICAL RELEVANCE/APPLICATION
Based on this study, the introduction of guidelines served as a platform to bring about those changes. Furthermore, the result of this study may be utilized for future revisions of the guidelines.

PHE003-b  Measurement of Electron Density Using Raw data-based Dual-energy Computed Tomography: Phantom Study (hardcopy backboard)

Toru Higaki PhD (Presenter): Nothing to Disclose, Yoko Kaichi : Nothing to Disclose, Chikako Fujioka RT : Nothing to Disclose, Masao Kiguchi RT : Nothing to Disclose, So Tsushima : Employee, Toshiba Corporation, Kazuo Awai MD : Research Grant, Toshiba Corporation Research Grant, Hitachi Ltd Research Grant, Bayer AG Research Consultant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd, Takuji Yamagami MD : Nothing to Disclose, Fuminari Tatsugami : Nothing to Disclose

Background
Electron density images for radiotherapy planning are generally calculated from conventional CT images. However, electron density does not correlate accurately with the CT number. Novel analysis software that utilizes raw data-based dual-energy CT (rDECT) data was recently developed for 320-detector CT scanners. The purpose of this phantom study was to evaluate the accuracy of the electron density map generated from rDECT data.

Evaluation
We scanned a phantom with a 320-detector-row CT instrument (Aquilion ONE VISION Edition, Toshiba Medical Systems, Tokyo, Japan). Scanning was at 80-135 kV, 800-140 mA, and 1.5 sec/rotation. The phantom was comprised of 27 cylinders filled with different solutions; 9 each contained various concentrations of iodine contrast media (iohexol, Omnipaque, Daichi-Sankyo Seiyaku), calcium chloride, and mixtures of iodine contrast media and calcium chloride (see also Table 1 of attached image). Although the mix ratio differed among the solutions, it was adjusted so that the CT number in the different solution was similar. We used a CT scanner that featured the new software for data analysis and measurements.

Discussion
In cylinders containing the calcium chloride solutions the CT number and electron density increased linearly in proportion to the concentration (row 3 in the attached Figure1 (a)(b)). In cylinders that contained the iodine solutions it also increased linearly in proportion to the concentration of the solutions but there was little change
in the electron density (row 1). With respect to the mixed solutions, the CT number was almost the same in all cylinders, however, the electron density increased linearly in proportion to the weight of the calcium chloride (row 2). Quantitative results are shown in Chart 1 (a)(b)(c). Our findings indicate that the calculated theoretical values and the values based on solution concentrations tended to be similar.

**CONCLUSION**

rDECT yields a more accurate electron density map than the conventional method using the CT number.

**PHE008-b**

**Fibroglandular and Fatty Tissue Volumes on Breast MR Images: Comparison of Random Walk Method and Texture Analysis (hardcopy backboard)**

**Fang-Jing Li (Presenter): Nothing to Disclose , Da-Tian Bau : Nothing to Disclose , Tzu-Ching Shih : Nothing to Disclose**

**Background**

Breast MRI provides a three-dimensional (3D) coverage of the entire breast with strong soft tissue contrast between fibroglandular (fibro) and fatty tissues (fat), thus making it suitable for the breast density analysis, which has been established as an independent risk factor associated with the development of breast cancer. Studies in breast density measurement using breast MRI are still limited and the main challenge is the segmentation of the whole breast from the body. The random walk (RW) method and the texture analysis (TA) are two state-of-art methods for image segmentation. The purpose of this study is to investigate the fibro and fat volumes by RW and TA in breast MRI.

**Evaluation**

Seven patients examined by breast MRI were included in this study. The MRI was performed on a 1.5T MR scanner with TR=8.0 ms, TE=2.0 ms, flip angle=10°, slice thickness = 2.5 mm. RW was applied to calculate the probability of label to each pixel and obtain the fibro volume. TA based on the grey level co-occurrence matrix was obtained to characterize the fibro from the breast. An example of segmentations on the fibro and fat tissues from the breast was represented in the supported figure (A) the breast MRI (B) fibro tissue segmented by TA (C) probability distribution calculated by RW (D) the fibro regions contours (red) using RW probability from the breast MRI. Correlation coefficient (CC) and mutual information (MI) were utilized to evaluate the similarity of the segmentations from RW and TA.

**Discussion**

The 3D rendering represents the similar fibro and fat volumes resulted from RW and TA. The high correlation (CC=0.82±0.06, MI=0.70±0.07) in comparison of RW and TA for fibro was acquired. CC and MI values were represented with the high positive correlation for evaluations in our patient cohort. The CC reflects the linear similarity between two segmented volumes by RW and TA, while MI also includes the non-linear aspects.

**CONCLUSION**

Our preliminary results suggest that RW and TA can achieve reasonable consistency to differentiate the fibro/fat tissue from breast in MRI. Both methods are potentially useful to evaluate the breast density in breast MRI.

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**QSE-TUB**

**Quality Storyboards Tuesday Poster Discussions**

**Quality Storyboards**

**SQ**

**AMA PRA Category 1 Credits ™ : .50**

**Tue, Dec 2 12:45 PM - 1:15 PM  Location: QS Community, Learning Center**

**Sub-Events**

**QSE105**

**Tailored Radiologist Reports Regarding Clinician Notification of Cerebral Infarct or Hemorrhage Exacerbations or Complications Improve Overall Compliance Rates (Station #1)**

**Bradley Neil Delman MD (Presenter): Nothing to Disclose , Amish H. Doshi MD : Nothing to Disclose , Thomas P. Naidich MD : Nothing to Disclose , Puneet Singh Pawha MD : Nothing to Disclose , Michael Sacher MD : Nothing to Disclose , Aryeh Stollman : Nothing to Disclose , Lawrence N. Tanenbaum MD : Speaker, General Electric Compnny Speaker, Bracco Group Speaker, Bayer AG Speaker, Siemens AG , Burton P. Drayer MD : Advisor, Hologic, Inc**

**PURPOSE**

Timely reporting of Critical Values enhances health care delivery. We recognize that it is important not only to report new/acute findings in those patients characterized prospectively as suspicious for undergoing 'acute stroke', but also to notify clinicians about new or expanded infarcts, or consequences thereof including mass effect or hydrocephalus, even for patients not specifically introduced as undergoing stroke alert studies. We aimed to determine if a tailored notification regimen could improve notification rates by radiologists in this patient population.
METHODS
At the end of each month (Feb 2013-March 2014) we mined all CT Head and MRI Brain reports from our practice. Using key phrases and excluding negating language, we developed a technique in Microsoft Excel to automatically refine the candidate exam list to about 6% of studies with highest probability for acute findings. The reports for these remaining studies were then reviewed for signs of new or increased infarction or hemorrhage, as well as increased mass effect, hydrocephalus, and other consequences meriting notification. Radiologists were provided with monthly customized reports summarizing their notification performance. We undertook several PDSA cycles. The first provided gross reporting success percentages for these critical values. In successive waves we provided 1) specific language from reports that warranted notification for each individual, then 2) examples of (anonymized) reporting failures to the entire group, then 3) report verbiage which indicated specifically why each case should have been reported, then 4) section-wide imaging examples and associated reports.

RESULTS
The reporting compliance increased from 83.3% to 94.4% (three month rolling averages), including four months at 100%. Subjectively there was greater awareness of the need to notify when imaging findings grew more conspicuous. Success is now documented and monitored by the Performance Improvement Committees of both Radiology and the Stroke Service.

CONCLUSION
Customized monthly reports informing radiologists of their specific success in documenting clinician notification of new or expanded infarcts or hemorrhages, and consequences thereof, enhances performance. Progressive PDSA cycles, with more illustrative presentation in each wave, led to even better performance overall. This method serves as a model that can be extended to other sections in the Department to enhance overall communication with clinicians.

QSE115
Using Team Audits to Improve Image Quality-Our Institution's Experience (Station #2)
Beth Winningham RT, MBA (Presenter): Nothing to Disclose, Lincoln L. Berland MD : Consultant, Nuance Communications, Inc Stockholder, Nuance Communications, Inc, Deborah D. Flint MBA : Nothing to Disclose

PURPOSE
The use of team review for image quality auditing has proven to be a beneficial part of quality management in our Radiology department. The team review allows the technologists working with the radiologists to become active participants in image quality management and improvement.

METHODS
There are currently three independent image quality audit teams in the Radiology department. The first team, formed in 2009, reviews CT imaging. This was followed in 2011 by the Diagnostic Radiograph audit team. Success with these two teams prompted the formation of a third audit team in 2013 to review MRI imaging. Each team is made up of technologists from the specified modality and radiologists who read them. Technologists and radiologists work together to identify the most common and/or problematic errors seen on the images and use these to determine the audit criteria. Detailed operational definitions are then established for each of the criteria to ensure consistency between all auditors and to allow for smooth transitions when new members join the teams. Random audits are conducted on a monthly basis. The teams meet monthly to review the results of the audits, identify the most common opportunities for improvement and discuss any questions or concerns that may arise from the audit. While the basic format of all the teams is the same, the specific audit process varies with each team depending on the type and volume of images being audited. The results of the audits are presented to the staff through staff meetings, notice boards and one to one communication. This format provides education to the staff for improving image quality issues. It also allows for identification of outstanding imaging so that technologists can be recognized for exceptional work and best practice standards for the departments can be determined.

RESULTS
Since the implementation of these teams there has been marked improvement in overall image quality. The percentage of errors for CT has decreased from 9.7% at the start to 5.2% at the end of 2013. Diagnostic Radiography audits are conducted in three sections: MSK, Chest and GI. Initial error rates were 12.7% (MSK), 14.5% (Chest) and 14.6% (GI). At the end of 2013 the rates had decreased to 4.4% (MSK), 5.0% (Chest) and 12.2% (GI). The MRI audit team ended 2013 with an error rate of 5.1% and is on track for that rate to decrease in 2014. Opportunities for improvement are more easily identified and improvement plans are determined by joint effort of the technologists performing the exams and the radiologists who read them. The team format has allowed for more open discussion between the technologists and the radiologists and the improvement in communication is also evident outside the teams. The staff has been more willing to be engaged in this process because they have an active hand in the improvements being made and take ownership of them.

CONCLUSION
Personal accountability and consistency in providing high quality images has improved as a result of the audits furthering our efforts to continuously improve safety and quality of care for our patients.

QSE123
Implementation of a Monitoring System for ACR and Proposed Joint Commission CT Requirements (Station #3)
QSE135

Susanna Claire Spence, MD (Presenter): Nothing to Disclose, Verghese George MBBS: Nothing to Disclose, Scott B. Serlin, MD: Nothing to Disclose, Eduardo Jose Matta, MD: Research Consultant, Pacific-Link Consulting

Purpose

Our county hospital has 330 beds, serves multiple outlying clinics, and is the state's busiest level III trauma center. The hospital has a single 1.5T MR to serve this population, placing an enormous burden on the magnet. It takes 6 weeks for an output to get an appointment for MR, with the magnet running extended hours daily 6:30am-9pm. The county will not allow reserved slots for inpt/ER add-ons, so they are squeezed in between, before, and after outpatients. The output slots are 45 mins long, but many of the scan protocols are outdated and long, running >1hr in those 45 min slots. This, in addition to inpt/ER addons, delays due to anesthesia and exam protocols not having been completed by the radiologist, resulted in almost half, 48.5%, of output waiting >1hr past their start time for their scan to begin. As many as 1 in 6 were waiting > 2 hours, and some over 4 hours past their scheduled start time. This results in pt frustration, with some walking out before their scan because they had to return to work, family. Primarily were not willing to wait. They then decided to be rescheduled, further delaying the information needed for their care. The county tried to address this by handing out lunch tickets to pts waiting long periods for their scan. ER and inpt physicians were often aggravated due to long delays waiting for urgent MRs to be performed between delayed outpatient slots.

Methods

To address this we used a multifaceted approach, using schedulers, MR technologists, administrative personnel, and representatives from the 3 major sections involved in writing the scan protocols (neuro, body and MSK). We set a goal to decrease the % of pts waiting >1hr from 48.5% to <33.3% within 6 months. Group discussions creating an Ishikawa diagram, along with walking the process, revealed several major problem areas that could...
Quality Improvement in Portable Chest Radiography: A Collaborative Approach (hardcopy backboard)

Trent Russell James MD : Nothing to Disclose , Rustain Lee Morgan MD, MS : Nothing to Disclose , Giendon G. Cox MD : Nothing to Disclose , Kimberly Smith : Nothing to Disclose , Jacqueline Hill MPH (Presenter): Nothing to Disclose

PURPOSE
Portable chest radiographs (PCXR) are the most frequently performed radiologic study at our institution with over than 40,000 exams completed from March 2013 to March 2014. Within these studies, there has been a significant increase in image acquisition errors, resulting in technical defects noticed by radiologists that can often prohibit accurate detection of pathology, potentially leading to misdiagnoses. This study aims to identify the frequency of the most commonly encountered PCXR technical defects, devise strategies to reduce or eliminate them, and reevaluate PCXR technical defects following strategy implementation to determine effectiveness.

METHODS
We initially randomly sampled 150 PCXRs from our PACS system from 8/25/2012 - 9/11/2012 (Cycle 1). Each of these radiographs were evaluated by a single radiologist with over 20 years of experience in cardiothoracic imaging for the presence or absence of the following technical defects: marking, too light, too dark, too flat, too sharp, centering, rotation, kyphosis/lordosis, lean, inspiratory effort or phase, motion, apices, angles, chest wall, collimation, grid or other artifacts, overlying lines/tubes, and display mask. Additional categories documented whether the study was unacceptable and repeated. The data was analyzed to determine the frequency of each defect and average number of defects per study. Results of the initial analysis were shared with radiologists, administrative supervisors, and technologists and methods to reduce each type of technical defect were discussed. Strategies for improvement were implemented and an additional random sample of 150 PCXRs from 11/15/2012 - 11/30/2012 were similarly evaluated to assess for defect reduction (Cycle 2).

RESULTS
Results of the first sample (n=150) revealed technical defects ranged from 2 to 11 per study, with an average of 5.33 technical defects per study (SD=1.64). The most frequently encountered defects included inappropriate use of image masking (97.3%), inappropriate use of collimation (96.7%), patient rotation (68.7%), overlying lines/tubes (61.3%), and poor inspiratory effort or expiratory phase imaging (53.3%). The least common defects were grid/other artifacts (1.3%), chest wall (3.3%), too sharp (6.0%), and kyphosis/lordosis (6.7%). Following strategy implementation, the third sample demonstrated a significant 30% decrease in the number of defects per study from 5.33 to 3.75 (SD=1.65) (p

CONCLUSION
Ensuring consistently high-quality PCXRs has become increasingly challenging as exam volume continues to rise. Given the inherent limitations of portable chest radiography, it is particularly important to minimize preventable technical defects to enable the highest possible diagnostic accuracy. Our study demonstrates that by implementing strategies collaboratively developed between radiologists and supervisory staff to educate and ensure accountability by radiologic technologists, technical defects in PCXRs can be significantly reduced. We plan to continue this process of education and quality improvement in PCXR and apply it to other types of radiologic exams to systematically improve image quality and resulting patient care.
Algorithm-based Imaging Approach for More Efficient Imaging Utilization in Suspected Appendicitis in a Pediatric Population

Ankaj Khosla MD (Presenter): Nothing to Disclose, Li Ern Chen MD: Nothing to Disclose, Mohamed Badawy MD: Nothing to Disclose, Rodica Pop: Nothing to Disclose, Jeannie K. Kwon MD: Nothing to Disclose

PURPOSE
Acute appendicitis is the most common abdominal condition requiring surgery in children. At our tertiary care children’s hospital, we treat more than 1100 children with appendicitis yearly. Ultrasound imaging, namely, ultrasound and CT, is an integral part of the workup for suspected appendicitis, with variable utilization practices dependent upon the clinical provider. Therefore, we developed an algorithm to aid in more efficient imaging modality selection for patients suspected of having appendicitis.

METHODS
A multidisciplinary team including physician and nursing representation from the emergency room, surgery and radiology departments convened to evaluate baseline data and develop evidence-based and consensus-based guidelines for a diagnostic algorithm for patients in whom appendicitis was suspected. Four specific deficiencies were identified that could result in improved outcomes: indications for diagnostic imaging, appropriate study choice (US vs. CT), technical performance in imaging, and consistency in radiologic reporting. The committee concurrently reviewed recent literature regarding clinical signs of appendicitis, imaging appropriateness and imaging criteria. To stratify patients according to their risk of having appendicitis, the emergency room clinicians began using the Pediatric Appendicitis Score (PAS). This score assigns patients to a low, moderate or high-risk category based on history, clinical and laboratory findings. Imaging studies were only recommended for patients with a moderate-likelihood of appendicitis. Ultrasound was the first-line imaging modality in patients with BMI < 30. Patients with BMI ≥ 30 or in whom perforation with abscess was suspected were recommended to proceed directly to CT imaging. To validate the PAS in our setting, we tracked the percentage of patients with each score who had appendicitis. In improving the technical aspect of studies, the committee placed emphasis on improving sonographic study performance. Technologists received a standardized protocol on how to conduct exams for appendicitis and received both didactic and hands-on training on preferred sonographic techniques. To aid patient comfort during the study, emergency room clinicians agreed that adequate pain control should be achieved before performing the study. Radiologists received training on reporting appendix ultrasound exams using a standardized reporting template that included primary and secondary findings. The final study impression (positive, equivocal or negative for appendicitis) was categorized based on specifically defined imaging features. These guidelines for radiologic workup were part of a comprehensive care algorithm for all three departments to follow. Data was gathered before and after implementation of the imaging pathway to track the imaging studies being ordered, as well as the rate of missed appendicitis. Pre-intervention results represent data 12 months prior to pathway implementation. Post-intervention results represent data 15 months post intervention. Fisher’s test was performed to compare the pre-intervention and post-intervention groups.

RESULTS
There were 1079 patients in the pre-pathway group and 1245 in the post-pathway group. Pre-intervention, the percentage of patients with a missed diagnosis of appendicitis was 5.1%. Post intervention, the rate is 3.1% (p = 0.02). The percentage of patients with the diagnosis of appendicitis receiving imaging studies has decreased from 80.0% to 71.9% (p= 0.001). Of these imaging studies, the percentage of patients receiving an ultrasound has remained steady at 63.3 to 64.1% (p= 0.838). CT utilization has decreased from 32.3 to 15.5 % (p = 0.02). The percentage of patients with the diagnosis of appendicitis receiving imaging studies has decreased from 80.0% to 71.9% (p= 0.001). Patients with a PAS score of 8-10 had a positive appendicitis rate of 75-87%. Those with a score of 1-3 had a positive appendicitis rate of 1-8%.

CONCLUSION
By implementing a multidisciplinary approach, we developed an imaging algorithm for the work-up of suspected appendicitis in a pediatric population. This algorithm has resulted in improvement of the missed diagnosis rate while decreasing CT utilization. We also utilized a standardized departmental protocol for performing sonographic studies for appendicitis and a template for reporting the results in standardized fashion. This algorithm can be implemented at other institutions and validated to determine its efficacy.
**ROS156**

**Dose-volume Analysis in Patients With Cervical Cancer Treated with Phased Intensity Modulated Radiotherapy and Concurrent Chemotherapy (Station #6)**

**Wenjuan Chen (Presenter): Nothing to Disclose**

**ABSTRACT**

Purpose/Objective(s): This study was to compare prospectively the volumetric and the dosimetric change of target volumes and organs at risk (OARs) during the course of intensity-modulated radiation therapy (IMRT) in locally advanced cervix cancer cases.

Materials/Methods: We conducted a comparative dosimetric analysis of 30 patients with cervix cancer who was treated by concurrent nedaplatin based chemotherapy and IMRT in period between March 2012 to September 2012 and CT and MR images were acquired for each patient before treatment and at 30Gy during treatment. All treatment plans were prescribed to deliver 50.4Gy to the planning tumor volume (PTV) for seven-field (7f-IMRT) using 6MV X-Ray. Following boost by brachytherapy (HDR) 21-28Gy/3-4 fraction. The target volumes and OARs were contoured based on the fused CT-MRI images by comparing the original plan and secondly plan. Two plans were done for every patient; the two techniques were then compared using dose volume histogram (DVH) analysis for the PTV, bladder, rectum, both femoral heads and Conformal Index (CI), Homogeneity Index (HI). Comparing different DVHs, it was found that the planning target volume (PTV) was adequately covered in both plans while it was demonstrated that the secondary 7 fields IMRT technique carried less doses reaching OARs (rectum, bladder, both femoral heads). The gross tumor volume (GTV) were 74.58 ±42.19 cm³; 40.19 ±23.27 cm³; The clinical tumor volume (CTV) is 634.05±173.0 cm³; 583.68 ±150.95 cm³ respectively. And tumor target volume were regressed on average 30.1±8.9% of the initial volume after treatment. In which 35 Gy average volume of Small intestine is 36.5+14.7%; 31.3±11.8%. Average volume of 40 Gy of small intestine was 27±12%; 23.5±10.6% respectively. There was statistical significance. (p=0.018). The OARs volume receiving 40Gy including rectum, bladder were 70.9±13.7%; 74.1±10.6% respectively and 69.8±11.1%; 69.0±9.1% respectively. And Conformal Index(CI) was0.73± 0.06; 0.74±0.06 respectively. Homogeneity Index (HI) was 0.24±0.05; 0.23±0.06 respectively. There were no significant differences in OARS and CI,HI. (p>0.05).

Conclusion: In our study, progression free survival with induction TP was 19.8 months which is consistent with results from large randomized studies of TAX 323 and TAX 324. However, grade 3 or higher neutropenia was observed in 31.5% of our study patients, compared to 76.9-83% with TPF in the large studies. While this is a small study of induction TP in a frail population, the results are promising and may warrant further study.

**Key words** Cervix cancer; Intensity modulated radiotherapy; Dose Volume Histogram; Radiation dosage

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**ROS159**

**Multi-Center Long Term Follow-up of Patients Treated for Merkel Cell Carcinoma (Station #7)**

**Jesse Shulman (Presenter): Nothing to Disclose, Francisco Myslicki : Nothing to Disclose, Andre Agassi : Nothing to Disclose, Sharon A. Saleniou MPH : Nothing to Disclose, Daniel E. Dosoretz MD : Nothing to Disclose, Constantine Mantz : Nothing to Disclose, Amy Fox : Nothing to Disclose, Steven Eric Finkelstein MD : Nothing to Disclose, Eduardo Fernandez-Victor MD, PhD : Nothing to Disclose, Yosef Rotterdam : Nothing to Disclose**

**PURPOSE**

Merkel cell carcinoma (MCC) is an aggressive neuroendocrine cutaneous malignancy that is seen with relative infrequency. There is no optimal standard of care for the treatment MCC. We report on a series of 191 cases to further elucidate the patterns of failure and the current most effective treatment techniques for this disease.

**METHOD AND MATERIALS**

This was a multi-center IRB-approved retrospective review of patients with MCC who underwent surgical excision and adjuvant radiotherapy (RT) between 1994 and 2008. Patients with recurrent or metastatic disease were excluded.

**RESULTS**
The median age was 76 years, with 89% Caucasian and 73% male. The median follow-up was 29.3 months. A majority of lesions (42%) were located on the head and neck, 31% upper extremity, 13% lower extremity, and 9% torso. Only 14% of patients underwent chemotherapy (CT) consisting of carboplatin/cisplatin and etoposide. Eighty-seven percent underwent wide local excision, 25% a re-excision, 9% Moh's microsurgery, 40% sentinel lymph node biopsy, and 22% a lymph node dissection. The median overall survival was 38.7 months. Nine percent of patients developed a local recurrence, 12% a nodal recurrence, and 16% distant metastasis. On univariate analysis, RT to the nodal basin was significantly associated with improved survival (median 27.9% vs 44.3%, p=0.0422). Patients who presented with a lesion in the torso experienced inferior survival than those who presented with a lesion in other areas (p=0.0263). Patients who underwent CT had a median survival of 57% compared to 36% for those who did not undergo CT, although this difference did not reach statistical significance (p=0.0711).

CONCLUSION

Patients who present with merkel cell carcinoma of the extremities or head and neck, and who are treated with RT to the draining nodes experience improved survival compared to those who present with a torso lesion and who do not receive nodal radiation. The role of CT remains unclear.

CLINICAL RELEVANCE/APPLICATION

Radiation therapy following surgical excision and including radiation to the nodal basin can improve survival in patients with localized merkel cell carcinoma.

**VIS-TUB**

**Vascular/Interventional Tuesday Poster Discussions**

**Scientific Posters**

**VIS241**

**Novel Subtracted CT Angiography Imaging Using Non-rigid Registration for Better Visualization of Spinal Dural Arteriovenous Fistulas (Station #1)**

Tatsuya Nishii MD (Presenter): Nothing to Disclose, Atsushi K. Kono MD, PhD: Nothing to Disclose, Mizuho Nishio MD, PhD: Research Grant, Toshiba Corporation, Hiromi Hashimura MD: Nothing to Disclose, Noriyuki Negi RT: Nothing to Disclose, Atsushi Fujita: Nothing to Disclose, Junya Konishi: Bayer Pharma FUJIFILM RI Pharma Co. Ltd., Eiji Kohmura MD, PhD: Nothing to Disclose, Kazuo Sugimura MD, PhD: Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

**PURPOSE**

CT angiography (CTA) prior to digital subtraction angiography (DSA) is useful for detecting the feeders of spinal dural arteriovenous fistulas (SDAVFs). However, identifying these feeders is sometimes time-consuming because they are small and run close to osseous structures. Non-rigid registration provides precise subtraction that can compensate for organ motion or transformation between two datasets. Thus, we hypothesized that subtracted CTA imaging using non-rigid registration (R-CTA) would facilitate the diagnosis of SDAVF feeders. The aim of this study was to evaluate the utility of R-CTA in patients with SDAVF in comparison with conventional CTA imaging (C-CTA).

**METHOD AND MATERIALS**

The records of 10 consecutive patients (63±13 years old, 1 female) who had undergone CTA and DSA for clinically suspected SDAVFs were retrospectively reviewed. From repeated CTAs performed at the arterial and late-arterial phases, deformed images of the late-arterial phase were obtained using non-rigid registration adjusted to the arterial phase images. Registration was performed using open-source Advanced Normalization Tools software. Next, R-CTA images were obtained by subtracting the deformed images from the arterial phase images. Both R- and C-CTA were analyzed with DSA results as a reference standard. The time required for detecting the SDAVF’s feeders, and their detectability, were analyzed for each patient. For each intervertebral foramen, the diagnosis likelihood of the feeders was scored on a 5-point scale (1=definitely negative, 5=definitely positive), and the accuracy was calculated. The difference between R-CTA and C-CTA was assessed by an ANOVA test and McNemar’s Chi-square test.

**RESULTS**

The required time to detection, and the detectability of, feeders using C-CTA vs. R-CTA were 96.1±39.1s vs. 49.3±27.3s (P<0.01), and 60% vs. 80% (P=0.15), respectively. When a feeder was scored ≥4, the accuracy in C-CTA vs. R-CTA was 94.5% (189/200) vs. 97.5% (195/200) (P=0.01), respectively.

**CONCLUSION**

R-CTA reduced the time required for detecting SDAVF feeders, and had better accuracy than C-CTA.

**CLINICAL RELEVANCE/APPLICATION**
Our subtracted CTA imaging technique using non-rigid registration helps clinicians to assess SDAVF feeders more quickly and accurately than the conventional method.

**VIS242**

**Troubling TAVR Studies: Incidental Findings in Patients Undergoing CT Angiography for Transcatheter Aortic Valve Replacement (Station #2)**

Phil Wu (Presenter): Nothing to Disclose, Farhood Saremi MD: Nothing to Disclose, Christopher Lee MD: Nothing to Disclose

**PURPOSE**

To determine the prevalence of significant incidental findings (SIF’s) on CTA angiography (CTA) in patients undergoing evaluation for transcatheter aortic valve replacement (TAVR). To evaluate the implications of SIF’s on clinical practice.

**METHOD AND MATERIALS**

181 patients underwent CTA of the chest, abdomen, and pelvis for TAVR evaluation between January 2011 and January 2014. CTA’s were retrospectively reviewed for concerning imaging findings (CIF’s). Electronic medical records were reviewed to determine which CIF’s represented SIF’s, with SIF defined as: (a) no clinical or imaging history of CIF prior to CTA and (b) no follow-up disproving the imaging finding. SIF’s were assigned to the following categories: possible malignancy, cardiovascular, non-malignant thoracic, non-malignant gastrointestinal, and non-malignant genitourinary.

**RESULTS**

112 of 181 patients (61.9%) were men; the mean age was 82.7±8.8 years. 90.6% (164/181) of patients had at least one CIF. 52% of CIF’s had clinical follow-up, surveillance imaging, or other diagnostic studies. Of the CIF’s that were followed-up, 42.2% resulted in new diagnoses or therapeutic interventions. 11% of CIF’s were known prior to CTA or were disproven on follow-up. 84.5% of CIF’s were not followed-up at our institution for the following reasons: immediate follow-up was not deemed clinically necessary as severe aortic valve disease was the primary determinant of patient prognosis, patients were often referred to our institution solely for TAVR, and 16 patients died within 3 months of CTA. Possible malignancy SIF’s were present in 54.7% (99/181), cardiovascular SIF’s in 52.5% (95/181), non-malignant thoracic SIF’s in 17.7% (32/181), non-malignant GI SIF’s in 22.7% (41/181), and non-malignant GU SIF’s in 6.6% (12/181) of patients. Attached table summarizes findings.

**CONCLUSION**

Although CTA evaluation of TAVR candidates is primarily utilized to characterize the anatomy of the aortic root and aortoiliofemoral arteries for candidate selection and procedural planning, CTA frequently reveals SIF’s that may alter the pre- or post-procedural management of TAVR candidates. Even if management is not altered per se, SIF’s can result in new diagnoses with implications on overall prognosis.

**CLINICAL RELEVANCE/APPLICATION**

As SIF’s can alter patient management and prognosis, radiologists should carefully examine preoperative CTA’s for CIF’s.

**VIS243**

**Kinetic Assessment of the Intimal Flap in Acute or Chronic Aortic Dissection Using Cine CPR and MPR Images Acquired by ECG-gated CT (Station #3)**

Noritaka Kamei (Presenter): Nothing to Disclose, Norio Hongo: Nothing to Disclose, Shinji Miyamoto: Nothing to Disclose, Rieko Shuto MD: Nothing to Disclose, Shunro Matsumoto MD: Nothing to Disclose, Satomi Ide: Nothing to Disclose, Mika Okahara MD: Nothing to Disclose, Shinya Ueda: Nothing to Disclose, Hiro Kiyosue MD: Nothing to Disclose, Hiromu Mori MD: Nothing to Disclose

**PURPOSE**

Our purpose is to assess the 4D data acquired from retrospective electrocardiographically(EGC) gated computed tomography(CT) using cine multiplanar reformation(cine MPR), and to characterize and define the kinetics of the intimal flap in acute or chronic aortic dissections.

**METHOD AND MATERIALS**

Twenty eight consecutive cases with Debakey III aortic dissection without prominent intramural thrombus who underwent ECG-gated CT from January 2010 to September 2013 were included in this study. Each CT scan was retrospectively reconstructed into sequential 10 axial datasets. Cine cross-sectional MPR images of the whole descending aorta were created. The maximum(Dmax) and minimum(Dmin) diameter of the true lumen at all time points was measured at each anatomic level. Maximum diameter change was calculated using following formula (Dmax-Dmin)/Dmax.

**RESULTS**

The Dmax in the proximal descending aorta reached its peak in early systole. There was a gradual and delayed wavelike movement of the peak toward the distal abdominal aorta. Dmax in the lower abdominal aorta was seen in diastolic phase. In an acute dissection group, the maximum diameter change, with collapse of the true lumen, was most frequently seen at the level of third lumbar vertebral body in systole. That was more prominent in the cases having no re-entry lower than the level of third lumbar spine, which included two cases with limb ischemia. There was less motion of the intimal in the chronic group than in the acute group.

**CONCLUSION**

Assessments of cine MPR images of the whole descending aorta acquired by ECG-gated CT revealed
complicated dynamic movement of the intimal flap in acute and chronic aortic dissections.

**CLINICAL RELEVANCE/APPLICATION**

This research addresses the unknown dynamic behavior of the septum in acute and chronic aortic dissections. The assessment of the motion of the intimal flap and the location of the re-entry described using CT may inform our clinical management of patients with Debakey III dissection.

**VIS239**

Proximal vs. Distal Occlusion of the Internal Iliac Artery Prior EVAR: Evaluation of Efficacy and Clinical Outcome (Station #4)

Alexander Dierks MD (Presenter): Nothing to Disclose, Alexander Sauer MD: Nothing to Disclose, Franziska Wolfschmidt MD: Nothing to Disclose, Nicole Hassold MD: Nothing to Disclose, Thorsten Alexander Bley MD: Nothing to Disclose, Ralph Kickuth MD: Nothing to Disclose

**PURPOSE**

Prior to endovascular aortoiliac aneurysm repair (EVAR) occlusion of the internal iliac artery (IIA) may be necessary to prevent an endoleak type II. We compared efficacy and clinical outcome after proximal occlusion of an unaffected IIA (ProxEmbx) using the Amplatzer vascular plug I (AVP) vs. distal occlusion of aneurysmatic IIA with coils and plugs (DistEmbx).

**METHOD AND MATERIALS**

Between 04/2009 and 12/2012 22 patients (mean age 74±8 years) underwent EVAR. In 9 patients with unaffected IIA occlusion was performed by a single AVP. In 13 patients with aneurysmatic IIA more distal embolization was conducted by using several coils and additional AVPs. The follow-up (mean 15±12.4 months) was based on clinical and radiological examinations (CTA and CEUS). Retrospectively, technical success, clinical outcome and complications were evaluated.

**RESULTS**

Embolization of the IIA was successful in all patients. Three patients with more distal embolization of aneurysmatic IIAs suffered from new onset sexual dysfunction after occlusion without statistically significant difference (p>0.05). Transient buttock claudication was observed in three patients in each group. Bowel ischemia did not occur. The procedure time in the ProxEmbx group was significantly lower (43±20 vs. 73±29 minutes; p=0.013). Fluoroscopy time for the ProxEmbx was also lower (14.6±4 vs. 29.2±7 minutes; p=0.038). There was no significant difference concerning radiation exposure (p>0.05), which was related to different BMI in both groups. There was no difference in the amount of contrast media (p>0.05).

**CONCLUSION**

Proximal occlusion of an unaffected IIA as well as more distal occlusion of an aneurysmatic IIA prior to EVAR have both the same technical and clinical outcome. However, proximal plug embolization has a significant lower procedure and fluoroscopy time.

**CLINICAL RELEVANCE/APPLICATION**

Proximal plug embolization of an unaffected IIA prior to EVAR is associated with shorter procedure and fluoroscopy time in comparison to more distal embolization of aneurysmatic IIAs.

**VIS240**

Optional IVC Filter Quality Improvement Project: Using the Electronic Medical Record (EMR) "Problems" List to Increase Retrieval Rates and Decrease Time to Filter Retrieval (Station #5)

Melissa Chittle MS (Presenter): Nothing to Disclose, Stephan Wicky van Doyer MD: Nothing to Disclose, George Rachid De Oliveira MD: Nothing to Disclose, Suvarna Ganguli MD: Research Grant, Merit Medical Systems, Inc Consultant, Boston Scientific Corporation, Raymond W. Liu MD: Nothing to Disclose, Rahmi Oktlu MD, PhD: Nothing to Disclose, Zubin Irani MD: Nothing to Disclose, Thomas Gregory Walker MD: Nothing to Disclose, Gloria Maria Martinez Salazar MD: Nothing to Disclose

**PURPOSE**

To compare retrieval rates and number of days to retrieval in patients with optional IVC filters before and after adding the notation "Retrievable IVC filter" to the patients electronic medical record "Problems" list.

**METHOD AND MATERIALS**

In this IRB-approved retrospective study, 314 patients (age 11 - 96 years; 142 females, 171 males) who underwent IVC filter placement for temporary indications between 01/11/2011 and 03/10/2014 were studied. Our study group (n=154) consisted of patients in whom a notation was made to the EMR Problems list following filter implantation that stated: "Retrievable IVC filter: This should be retrieved when no longer indicated for PE protection". The control group (n=160) had no such notation. All patients' demographics, filter placement indications, procedure dates (filter placement/retrieval), complications, days to retrieval, retrieval rates and referral rates (patients who were referred by a clinician to IR for filter retrieval) were recorded. Statistical analysis was performed using a Fischer's exact test and unpaired t test.

**RESULTS**

There were no significant differences in demographics and filter placement indications between the control (n=160) and study groups (n=154). IVC filter retrieval rates in the study group (69/154; 42%) were
significantly higher (p=0.0001) than the control group (31/160;19%). Direct patient referrals from clinicians for filter retrieval increased significantly in the study group (27/154; 18%;p=0.0001), as compared to the control group (5/160;3%). The number of days from insertion to filter retrieval in the study group (Mean 132.2, SD 98.786, SEM 7.96) was significantly less (p=0.001) than in the control group (Mean 237.75 days, SD 189.8, SEM 15.00)

CONCLUSION
In this study, adding the notation "Retrievable IVC Filter" to the patients' electronic medical record "Problems" list significantly increased patient referral to IR for filter retrieval, increased the overall filter retrieval rates and decreased the number of days to filter retrieval

CLINICAL RELEVANCE/APPLICATION
There are complications secondary to indwelling IVC filters (migration, fracture and DVT) in patients with optional filters. Therefore, continuous monitoring is paramount to ensure timely filter retrieval.

VIS244

Dual-phase Cone Beam CT Improves Identification of Cholangiocarcinoma Lesions during Trans-arterial Chemoembolization (Station #6)

Ruediger Egbert Schernthaner 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-François H. Geschwind MD: Consultant, BTG International Ltd Consultant, Bayer AG Consultant, Guerbet SA Consultant, Nordion, Inc Grant, BTG International Ltd Grant, F. Hoffmann-La Roche Ltd Grant, Bayer AG Grant, Koninklijke Philips NV Grant, Nordion, Inc Grant, ContextVision AB Grant, CeloNova BioSciences, Inc Founder, PreScience Labs, LLC CEO, PreScience Labs, LLC

PURPOSE
To evaluate the impact of dual-phase cone-beam CT (CBCT) on the identification of cholangiocarcinoma (CCC) lesions during transarterial chemoembolization (TACE) compared to conventional DSA, in relation to pre-interventional contrast-enhanced magnetic resonance imaging (CE-MRI) of the liver.

METHOD AND MATERIALS
This retrospective study included 17 consecutive patients (10 men, 7 women; mean age 64) with CCC who underwent pre-interventional CE-MRI of the liver and intra-procedural dual-phase (early and delayed arterial) CBCT just before the chemotherapeutic drug delivery. The degree of visibility of each CCC lesion was graded on a three rank scale (complete, partial and none) on dual-phase CBCT and DSA images and compared to CE-MRI. Lesions < 5 mm diameter or outside the CBCT's field of view were excluded from evaluation. Statistical analysis was performed with Wilcoxon signed-rank test and Friedman test.

RESULTS
At total of 61 CCC lesions was included. The sensitivity of DSA for the complete or partial depiction of CCC lesions was only 45.9%, whereas early and delayed arterial phase CBCT had significantly higher sensitivity of 73.8% and 93.4%, respectively (p<0.01). There was only one lesion (1.6%) that was depicted by DSA, but not by dual-phase CBCT due to severe streak artifacts caused by a mitral valve replacement. Conversely, out of the 33 lesions not visible on DSA, 18 (54.5%) and 30 (90.9%) were revealed on early and delayed arterial phase CBCT images, respectively. Early arterial phase CBCT showed no additional lesions compared to delayed arterial phase CBCT. Delayed arterial phase CBCT identified significantly more lesions (n=12, 19.7%, p<0.01) than early arterial phase CBCT. Especially with regard to the complete delineation of lesions, delayed arterial phase CBCT yielded significantly higher sensitivity (78.7%) compared to early-phase CBCT (31.1%) and DSA (21.3%) (p=0.01).

CONCLUSION
Dual-phase CBCT significantly improved the identification of CCC lesions during TACE. Delayed arterial phase CBCT yielded the highest sensitivity for the complete delineation of CCC lesions. Dual-phase CBCT should be used as standard imaging technique during TACE in CCC patients.

CLINICAL RELEVANCE/APPLICATION
Dual-phase CBCT can help to identify CCC lesions during TACE thus preventing some lesions to be overlooked for optimal treatment.

VIE174

Radation Cataractogenesis in Interventional Radiology: A Review for the Interventional Physician (Station #7)

Kevin Frederick Seals MD (Presenter): Nothing to Disclose, Ramsey al-Hakim MD: Nothing to Disclose, Christopher H. Cagnon PhD: Nothing to Disclose, Stephen Thomas Kee MD: Nothing to Disclose, Edward Wolfgang Lee MD, PhD: Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is:

1. To provide a comprehensive overview of radiation cataractogenesis in interventional radiology
2. To review the operator lens doses seen in common IR procedures and the data linking cataract development with interventional work
3. To describe optimal lens protection for the IR physician and strengths and weaknesses of each protection technique
TABLE OF CONTENTS/OUTLINE

Background
- ICRP threshold guidelines, data motivating the 2011 threshold change [Figure 1]
- Mechanistic basis of radiation cataract, including the role of radiation genotoxicity
- Assessment of the stochastic versus deterministic nature of radiation cataractogenesis [Figure 2]

Data linking radiation exposure and cataract development in interventional physicians [Figure 3]
- Multiple studies showing a statistically significant increase in cataract risk in interventionists
- Factors modulating this risk

Lens dose in common IR procedures [Figure 4]
- Physician lens dose in TIPS, CT guided biopsy and drainage, vertebroplasty, chemoembolization, neurointerventional techniques, etc.

Critical analysis of lens protection strategies [Figure 5]
- Leaded eyeglasses
- Ceiling-suspended shields
- Complex commercial shielding devices
- Real-time dosimetry
- Radiation education

GE Healthcare: GE Healthcare Breast Health Advantage: 3D Automated Breast Ultrasound (ABUS): An Interactive Hands on Workshop

Vendor Workshops

Tue, Dec 2 1:00 PM - 2:00 PM   Location: Booth 4773

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.

MSAS33

Management of Portal Hypertension (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Multisession Courses

IR  GI

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

Tue, Dec 2 1:30 PM - 3:00 PM   Location: S105AB

Participants

Moderator
David Brent Nicholson : Nothing to Disclose
Moderator
Steven P DeColle : Nothing to Disclose

Sub-Events

MSAS33A

TIPS (Tranjugular Intrahepatic Portal Systemic Shunts)

Harneil Singh Sidhu MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) When are indications for a TIPS procedure? 2) Pre-procedure workup for a TIPS procedure? 3) How is a TIPS performed. 4) What are some post procedure issues that occur.
LEARNING OBJECTIVES

1) Summarize the pathologic anatomy and hemodynamics associated with gastric and ectopic varices.
2) Describe the varying techniques of portosystemic collateral embolization, and balloon occluded transvenous obliteration (BRTO and BATO) for the management of gastric varices. 3) Identify the skillset and tactics for practice bulging and clinical patient selection. 4) Describe the techniques for transvenous sclerosis of ectopic varices will be described.

ABSTRACT

This session will describe the pathologic anatomy and hemodynamics associated with gastric and ectopic varices. The varying techniques of portosystemic collateral embolization and balloon occluded transvenous obliteration (BRTO and BATO) for the management of gastric varices are also reviewed. Practice bulging and clinical patient selection will also be addressed. Advanced techniques for transvenous sclerosis of ectopic varices will be described.

Portal Hemodynamics - Post Intervention

Wael E. A. Saad MBBCh (Presenter): Research Grant, Siemens AG Research Consultant, Siemens AG Consultant, Boston Scientific Corporation Consultant, Getinge AB Consultant, Merit Medical Systems, Inc

LEARNING OBJECTIVES

1) The attendees will know the various types of percutaneous portal procedures performed. 2) The attendees will understand the hemodynamic definitions and concepts of inflow and outflow. 3) The attendees will understand that increasing antegrade portal venous does not necessarily increase the functional inline portal venous flow to the liver hepatocytes. 4) The attendees will understand what procedures are categorized as procedures that would increase or decrease inline portal venous inflow. 5) The attendees will understand the correlations between nominal portal pressures, pressure gradients and portal flow (velocity, volume and direction).

ABSTRACT

Abstract: Portal interventions include: Transjugular Intra hepatic Portosystemic Shunts (TIPS), portal vein angioplasty / Stenting, Balloon-occluded retrograde Transvenous obliteration (BRTO), hepatic venous interventions for Budd-Chiari, para umbilical vein occlusion and extrahepatic Portosystemic shunt occlusion. The lecture will discuss the effects of these procedures on nominal portal pressures, pressure gradients and portal flow (velocity, volume and direction) and inline portal blood flow to the functional liver (hepatocytes).

Case-based Review of Nuclear Medicine: PET/CT Workshop—Cancers of the Abdomen and Pelvis (In Conjunction with SNMMI) (An Interactive Session)

Multisession Courses

<table>
<thead>
<tr>
<th>MSAS33B</th>
<th>BROTO/BATO Balloon Occluded Retrograde Tranvenous Obliteration of Varicose Veins/Balloon Occluded Antegrade Transvenous Obliteration of Varicose Veins</th>
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<tbody>
<tr>
<td>Jun Koizumi MD, PhD (Presenter): Nothing to Disclose</td>
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</table>

LEARNING OBJECTIVES

1) Discuss the role of PET/CT in the staging and follow up of common gastrointestinal tumors like colon adenocarcinoma. 2) Evaluate the role of PET/CT in gynecologic malignancies. 3) Discuss the importance of PET/CT in determination of early response in gastrointestinal stromal tumors. 4) Discuss the role of PET/CT in evaluation of select renal and prostate malignancies. 5) Be familiar with limitations of PET imaging in evaluating certain conditions like malignant ascites, peritoneal and omental metastasis and the importance of careful evaluation of CT findings in addition to the FDG PET image.

ABSTRACT

PET/CT has increasingly become the modality of choice for initial evaluation and follow up of patients with many gastrointestinal cancers including colorectal, esophageal and gastric cancer, pancreatic adenocarcinoma and hepatobiliary malignancies. Unlike
the conventional radiologic modalities, change in FDG uptake can help identify responders even 4 to 5 weeks after chemotherapy for most cancers and much earlier for the gastrointestinal stromal tumors. PET/CT can also aid in the evaluation of indeterminate lesions like lung nodules, hepatic masses and lymph nodes. While the role of FDG PET in renal, prostate and bladder cancer is still being defined, it has a high positive predictive value and can be used for evaluation of lesions seen on other conventional imaging. In gynecological cancers PET/CT is predominantly used for patients with locally advanced disease or suspected recurrence. PET is also being increasingly incorporated into radiotherapy planning for dose delineation and modification according to metabolic activity.

MSES33
Essentials of Chest Imaging
Multisession Courses

CH
AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 1:30 PM - 3:00 PM Location: S100AB

Sub-Events

MSES33A The Mediastinum: A Case-based Approach
Jared Dean Christensen MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review common pitfalls in the diagnosis of mediastinal disease. 2) Discuss the role of radiography, CT, MR, and PET for characterizing mediastinal masses.

ABSTRACT

Mediastinal pathology is often incidentally detected at imaging and can present a diagnostic challenge. Imaging features are often non-specific and definitive diagnosis frequently requires tissue. However, a systematic approach to mediastinal interpretation can facilitate disease detection, help narrow the differential diagnosis, and direct appropriate management. This presentation will review the role of chest radiography, CT, MR, and PET imaging in the evaluation of mediastinal disease utilizing a case-based approach.

MSES33B Micronodular Lung Disease
Ioannis Vlahos MRCP, FRCR (Presenter): Research Consultant, Siemens AG Research Consultant, General Electric Company

LEARNING OBJECTIVES

This course provides a practical schema for interpreting micronodular lung disease. This is based on understanding how pathological processes affect the lung microanatomy which in turn is reflected in variant HRCT appearances. The emphasis is on understanding terminology, differentiating pathology, maximizing the use of technology and avoiding interpretative pitfalls.

MSES33C Pulmonary Edema
Melissa L. Rosado De Christenson MD (Presenter): Author, Thieme Medical Publishers, Inc Author, Amirsys, Inc Author, American Registry of Pathology Author, Oxford University Press

LEARNING OBJECTIVES

1) To define pulmonary edema and list its various types. 2) To identify typical radiographic and CT findings of pulmonary edema. 3) To recognize conditions that mimic pulmonary edema.

ABSTRACT

Pulmonary edema is the abnormal accumulation of extravascular lung water and is often classified as cardiogenic and non-cardiogenic types. Interstitial edema manifests on radiography with perihilar haze, subpleural edema, peribronchial cuffing, and septal thickening. Alveolar edema may manifest with consolidation on radiography and with ground-glass and acinar opacities or consolidation on chest CT. Interstitial edema typically exhibits rapid onset and resolution. Alveolar edema may have a rapid onset, but clears slowly.

MSQI33
Staff and Patient Safety: The Lean Toolbox in Practice
Multisession Courses

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

Moderator  
Ella A. Kazerooni MD : Nothing to Disclose

**LEARNING OBJECTIVES**

(This course is part of the Quality Improvement Symposium)

**Sub-Events**

**MSQI33A**  
The Egregious 8-Getting Rid of Waste (and Non-value Added Activities) in Radiology

Paul G. Nagy PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Discussion around the definition of waste (muda) in quality management. 2) Characterizations of types of waste. 3) Examples of radiology quality improvements projects for each type of waste. (This course is part of the Quality Improvement Symposium)

**ABSTRACT**

Quality improvement is not just preventing unnecessary harm to patients. Quality Improvement is creating an environment where optimal patient care is consistently delivered. Waste a defined in lean quality management is defined as any activity that consumes resources without creating value to the end customer. The types of waste can help someone think about opportunities for improvement for a quality improvement project.

**MSQI33B**  
Mistake Proofing Imaging Processes

Lucy W. Glenn MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the culture of safety. 2) Understand the different levels of mistake proofing. 3) Understand the different components used to mistake proof a process. (This course is part of the Quality Improvement Symposium)

**MSQI33C**  
Improving Flow and Patient Throughput: Value Stream Mapping

David M. Paushter MD (Presenter): Advisory Panel, AIM Specialty Health

**LEARNING OBJECTIVES**

1) Understand the meaning of 'waste' when applied to health care in lean terminology. 2) Learn the basic methods of value stream mapping to gain improvements in efficiency of flow and patient throughput. 3) Understand the organizational imperatives required to successfully implement value stream mapping. 4) Learn the critical role of direct, collaborative observation of processes in understanding waste and improving function. (This course is part of the Quality Improvement Symposium)

**ABSTRACT**

Value Stream Mapping is an important Lean tool that has been applied successfully to improve flow and patient throughput in healthcare environments. Applications of this technique require mapping by direct observation the complex pathways of patient care that occur from the perspectives of all participants, including physicians, nurses, technologists, receptionists, supply chain, space design, environmental services and most importantly, patients. This requires defining the terms 'waste', 'product' and 'customer', and describing all facets of patient, care team, materials and product flows involved in care situations. Ultimately significant improvements in communication, wait times, efficiency of movement, utilization of resources and quality of service can be achieved. The goal of this session is to provide an introduction to Value Stream Mapping, its role in Lean transformation and its application to common clinical situations.

**URL's**


**Active Handout**


**PS30**

Tuesday Plenary Session

**Plenary Sessions**

**AMA PRA Category 1 Credits ™:** 1.25
Participants
Presiding
N. Reed Dunnick MD Nothing to Disclose President, Radiological Society of North America

Sub-Events

Presentation of the Gold Medal of the Radiological Society of North America
Gary J. Becker MD (Presenter): Nothing to Disclose Allen S. Lichter MD (Presenter): Board of Directors, Varian Medical Systems, Inc Etta D. Pisano MD (Presenter): Founder, NextRay, Inc CEO, NextRay, Inc Research Grant, Koninklijke Philips NV Research Grant, Siemens AG Research Grant, Siemens AG Equipment support, Koninklijke Philips NV Research Grant, Koninklijke Philips NV, N. Reed Dunnick MD Nothing to Disclose

Annual Oration in Diagnostic Radiology: Transitioning from Volume-Based to Value-Based Practice: A Meaningful Goal for All Radiologists or a Meaningless Platitude?
David C. Levin MD (Presenter): Consultant, HealthHelp, LLC Board of Directors, Outpatient Imaging Affiliates, LLC, N. Reed Dunnick MD Nothing to Disclose

This centennial year of the RSNA meeting is a good time to reflect on past successes, but also to recognize that radiology is at a crossroads. We face many threats, ranging from commoditization, to declining reimbursements, to the perception that much imaging is unnecessary, to termination of groups by hospitals, etc. One of our biggest challenges - and a way to counter some of these threats - is to effectively move from our current volume-based practice model to one which is more value-oriented. This oration will present concrete ideas on steps that need to be taken to accomplish that goal. Radiologists must refute the notion that we are simply purveyors of a commodity by starting to act like true consulting physicians. True consulting physicians would take a more active role in activities like assessing the appropriateness of requests for imaging, supervising the performance of the studies, communicating the results to patients, and being more available to consult with referring doctors. Of course, doing these things takes time away from reading cases, and that will lead to lower incomes. I will make the case that this is a worthwhile and necessary tradeoff. Primary care physicians and specialists in clinical disciplines spend hours each day providing uncompensated services to patients, and we have to start doing some of that as well. While it may not be feasible to try to evaluate the appropriateness of every imaging request or to directly supervise every study being done, there are ways we can do to add value to these processes of care. A side benefit of taking the time to act like true consultants is that it will create more jobs for young radiologists, who are having trouble finding them now. We owe them that. Radiologists will also provide greater value if they make themselves available around the clock to help their patients and referring doctors, rather than outsourcing night and weekend work to others outside their practice. Greater focus on quality is another way to provide value. Programs like the Physician Quality Reporting System have imposed quality measures upon radiology practices, but some of them are neither useful nor easily measurable, and fail to provide any true indication of the quality of a practice. Radiology groups could provide better value by creating and tracking their own internal quality metrics, as some have already done. Still another way for radiologists to provide value is to develop closer ties to primary care physicians, who are often overburdened and need our help, and who are going to become increasingly influential players in an era of ACOs and bundled payments. One way we can do this is to propose what might be termed “the 90% rule.” If all these suggestions are followed, I believe that within 5 years radiology will be considered a high-value specialty that is more helpful to our patients and referring physicians than at present, and one that is no longer viewed as a commodity by others in the rest of the medical world.

Interventional Oncology Series: Liver Metastases

Series Courses

AMA PRA Category 1 Credits ™: 4.25
ARRT Category A+ Credits: 5.00
Tue, Dec 2 1:30 PM - 6:00 PM Location: S405AB

Participants
Moderator
Michael Christopher Soulen MD: Royalties, Cambridge University Press Consultant, Guerbet SA Research support, Guerbet SA Consultant, BTG International Ltd Research support, BTG International Ltd Consultant, Merit Medical Systems, Inc Speaker, Sirtex Medical Ltd

LEARNING OBJECTIVES
This session will review the multidisciplinary management of liver metastases from colorectal cancer and neuroendocrine tumors, the unique feature affecting assessment and triage of each tumor type, and integration of image-guided therapy with systemic therapies. Didactic material will be reinforced by tumor board style review of clinical cases.

ABSTRACT
see individual lecture abstracts

Sub-Events

Setting the Stage: NCCN/ESMO Guidelines for mCRC
VSIO31-02  Going for Cure: Multidisciplinary Conversion to Resectability

Robert E. Roses MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the contemporary paradigm for the management of hepatic metastases (with an emphasis on colorectal cancer liver metastases). 2) Describe criteria for resectability. 3) Discuss the interplay between systemic chemotherapy and surgical approaches. 4) Discuss the interplay between interventional radiology techniques and surgical approaches. 5) Discuss alternative treatment sequences for patients with synchronous liver metastases.

ABSTRACT

The last decade has witnessed an expanding role for resection in the management of metastatic colorectal cancer. Traditional exclusion criteria for liver resection have largely been abandoned. The contemporary paradigm for the management of liver metastases emphasizes the preservation of a sufficient liver remnant. Assessment of resectability depends on a careful review of preoperative imaging and is facilitated by volumetric measurement. In addition, because of the greater efficacy of chemotherapy, a subset of patients who are initially unresectable are downstaged to resectability. Systemic therapy may also allow for the more rational application of aggressive surgical approaches. Interventional approaches, in particular portal vein embolization may further expand the number of resection candidates or allow for safer application of extended hepatectomy. In patients with synchronous metastases reverse sequencing, and combined resections are increasingly utilized. Finally, two-stage hepatectomy may allow for complete resection of bilobar metastatic disease.

VSIO31-03  DW-MRI vs. PET/CT for Assessment of Early Treatment Response of Liver Metastases to Y90-Radioembolisation: First Results

Alexandra Barabasch MD (Presenter):  Nothing to Disclose, Nils Andreas Kraemer:  Nothing to Disclose, Alexander Ciritsis:  Nothing to Disclose, Nienke Lynn Hansen MD:  Nothing to Disclose, Philipp Bruners MD:  Nothing to Disclose, Christiane Katharina Kuhl MD:  Nothing to Disclose

PURPOSE

We report on the first results of an ongoing study that aims at comparing the accuracy of liver DW-MRI to PET/CT for early response-assessment after trans-arterial Y90-radioembolisation (Y90-RE).

METHOD AND MATERIALS

Between June-2010 and December-2013, 145 Y90-RE in 85 patients were performed. Patients who (1) had liver-metastases from solid cancers, and (2) had at least 3 measurable target-lesions in the right liver lobe were included. 25 patients (16 colorectal, 8 breast and 1 CUP) met the inclusion criteria and underwent PET/CT and DW-MRI of the liver within 6 weeks before and within 4-8 weeks after Y90-RE. An increase in minimal ADC (ADCmin) and a decrease in maximal SUV (SUVmax), respectively, of at least 30% after Y90-RE was regarded as positive response. In diverging response classifications, the final outcome of the patient was used to distinguish true from false response-classifications.

RESULTS

Two patients (2/25, 8 %) were FDG-negative on pre-therapeutic PET, leaving 23 for DWI/PET-correlation. After Y90-RE, overall SUVmax decreased from 7.90 ± 2.75 to 5.47 ± 2.06 (p<0.0001). Minimal ADC (ADCmin) increased from 0.53 ± 0.14 *10-3 mm2/s to 0.73 ± 0.29 *10-3 mm2/s (p=0.0035). A strong inverse correlation was observed for post-therapeutic ADCmin and SUVmax (r=-0.73). Concordant response-classification was observed in 19/23 patients (83 %), discordant in 4/23 (17 %). In 3/4, response based on DWI was confirmed by follow-up. PPV to predict presence of response was 14/15 (93 %) for MRI and 11/10 (91 %) for PET. NPV to predict absence was 10/10 (100 %) for MRI and 10/14 (71 %) for PET. The sensitivity for detecting response was significantly higher for MRI (100 %; 14/14) than for PET (71%; 10/14) (p<0.004).

CONCLUSION

DW-MRI appears to be significantly more sensitive than PET/CT for demonstrating early response after Y90-RE in patients with secondary liver tumors.

CLINICAL RELEVANCE/APPLICATION

DW-MRI should be preferred for early response assessment after Y90-RE, since it appears to be significantly more sensitive compared to PET/CT.

VSIO31-04  Going It Alone: Ablation for Cure

Luigi Solbiati MD (Presenter):  Nothing to Disclose
LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
For hepatic metastases from colorectal cancer ablation is generally used in small volume liver disease in inoperable patients. For many years survival data following ablation (median survival of 3 years and 5-year survival approaching 30%) have been better than any published chemotherapy alone data and slightly worse than those achieved after liver resection. More recently, thanks to further improvements of ablation technologies and techniques, it has been demonstrated that local control of colorectal metastases within the 2-cm and the 2-3 cm size ranges approaches respectively 100% and 85-90%, thus being comparable with most surgical series. In addition, in recent reports, long-term follow-up results up to 10 years in patients with appropriately selected hepatic metastases from colorectal cancer were essentially equivalent to those from surgical resection, even preserving the traditional advantages of ablation vs surgery (less invasiveness, repeatability, lower complication rates, etc.). These findings highlight the viability of ablation as an alternative treatment not only in the large number of patients who are ineligible for surgical resection, but also for patients who could undergo surgery, provided that accurate selection of cases is applied and the most advanced technologies and techniques to guide and perform ablations are employed. Of course, combinations of ablations and chemotherapy are by far preferable to ablation alone, but ablation should still be offered to patients who cannot receive chemotherapy.

Palliative Embolotherapy: New Technology, New Promises?
Tobias Franz Jakobs MD (Presenter): Speaker, Sirtex Medical Ltd Research Consultant, Sirtex Medical Ltd Speaker, Siemens AG Speaker, Terumo Corporation Speaker, Surefire Medical, Inc

LEARNING OBJECTIVES
1) Palliative embolization for different tumor entities. 2) Indications for palliative embolotherapy. 3) Products and devices for embolotherapy.

ABSTRACT
Embolisation has become an accepted modality of cancer treatment in patients with a variety of clinical scenarios. It is commonly used in clinical practice in the treatment of hepatocellular carcinoma, hepatic metastases from colorectal and breast cancer and neuroendocrine tumors. This review summarizes the current evidence for the efficacy of embolotherapy in these clinical settings, together with the associated complications and future options.

Transarterial Chemoembolization in Soft-Tissue Sarcoma Metastases to the Liver – The Use of Imaging Biomarkers as Predictors of Patient Survival
Julius Chapiro MD (Presenter): Nothing to Disclose Rafael Duran MD: Nothing to Disclose MingDe Lin PhD: Employee, Koninklijke Philips NV Ruediger Egbert Schernthaner 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, Celona BioSciences, Inc Founder, PreScience Labs, LLC CEO, PreScience Labs, LLC

PURPOSE
To evaluate the role of imaging biomarkers of tumor response in soft-tissue sarcoma (STS) metastases to the liver treated with conventional transarterial chemoembolization (cTACE).

METHOD AND MATERIALS
This study was a retrospective analysis of 25 patients with STS metastases to the liver treated with cTACE. Each patient underwent contrast-enhanced MRI (ceMRI) within 6 weeks before and after therapy. Tumor response of the largest target lesion was assessed on arterial-phase MRI in each patient using RECIST, modified RECIST and EASL guidelines. In addition, a segmentation-based 3D quantification of the enhancing tumor volume (quantitative [q] EASL) was performed. For each method, patients were classified as responders (R) and non-responders (NR) and evaluated using Kaplan-Meier analysis. Overall survival (OS) and progression-free survival (PFS) of the entire cohort were calculated. Clinical parameters (performance, tumor status, treatment history) were included into a multivariate analysis of Cox proportional hazard ratios (HR).

RESULTS
A total of 65 procedures (mean, 2.6/patient) were performed. Median OS of the entire cohort was 21.2 months (95% CI, 13.4-28.9) and PFS was 6.3 months (95% CI, 4.45-8.2). No patient was classified as R according to RECIST, while 11 (44%), 12 (48%) and 12 (48%) patients were R according to EASL, mRECIST and qEASL, respectively. Multivariate analysis identified tumor response according to mRECIST and qEASL as reliable predictors of improved patient survival (P=0.019; HR 0.3 [0.1-0.8] and P=0.006; HR 0.2 [0.1-0.6], respectively).

CONCLUSION
This study demonstrated the advantages of enhancement-based tumor response assessment over size-based RECIST analysis of STS metastases to the liver and validated qEASL as the most predictive assessment method after cTACE.

CLINICAL RELEVANCE/APPLICATION
The validation of mRECIST and qEASL as prognostically relevant imaging biomarkers of tumor response might help to identify non-responders sooner for potential re-treatment in this rare disease.

**VSIO31-07**  
**mCRC Tumor Board**

Mary F. Mulcahy MD (Presenter): Nothing to Disclose, Robert E. Roses MD (Presenter): Nothing to Disclose, Luigi Solbiati MD (Presenter): Nothing to Disclose, Tobias Franz Jakobs MD (Presenter): Speaker, Sirtex Medical Ltd Research Consultant, Sirtex Medical Ltd Speaker, Siemens AG Speaker, Terumo Corporation Speaker, Surefire Medical, Inc

**LEARNING OBJECTIVES**

1) Apply knowledge regarding interventional oncology treatment options for colorectal cancer to clinical practice. 2) Enhance awareness regarding the potential benefits and limitations of interventional oncology therapies to more effectively treat patients with colorectal cancer. 3) Describe the best sequence of treatment options for patients diagnosed with colorectal cancer and apply knowledge gained to improve overall survival.

**ABSTRACT**

Patients who benefit most from multidisciplinary decision making are patients who do not have a clear option for treatment based on marginal indication for surgery, poor theoretical success of systemic therapies, and potential treatment with unproven therapeutic options. Locoregional therapy by interventional radiology frequently arises in these situations and it is important that interventional radiology be a part of this team to explain how interventional oncology techniques complement traditional medical, radiation, and surgical options. As cancer therapeutics continue to change, interventional radiology will be central in both the diagnostic and therapeutic aspects of targeted and personalized therapy.

**VSIO31-08**  
**Setting the Stage: Triage of mNET**

Michael Christopher Soulen MD (Presenter): Royalties, Cambridge University Press Consultant, Guerbet SA Research support, Guerbet SA Consultant, BTG International Ltd Research support, BTG International Ltd Consultant, Merit Medical Systems, Inc Speaker, Sirtex Medical Ltd

**LEARNING OBJECTIVES**

1) Review current assessment and grading of gastroenteropancreatic neuroendocrine tumors. 2) Outline a system for triage of patients with liver metastases. 3) Discuss integration of image-guided and systemic therapies.

**ABSTRACT**

Once considered rare, the incidence and prevalence of neuroendocrine tumors (NET) have increased rapidly, with a more than five-fold increase in incidence in the United States from 1973 to 2004 and an prevalence that is two- to five-times that of esophageal cancer, gastric cancer, pancreatic cancer, and hepatobiliary cancer. The typically long delay in diagnosis of NETs and their propensity for hepatic metastases create an important role for liver-directed therapies. Challenged by the shortage of physicians experienced in the diagnosis and management of this disease, these long-lived patients often access strong advocacy groups and web-based support sites which direct them to centers of excellence with physician teams that offer a complete understanding of the spectrum of their disease. It is essential that interventional oncologists develop an intimate knowledge of the characteristics and management of neuroendocrine tumors in order to know how and when best to apply the armamentarium of image-guided therapies, and guide patients in integrating these with surgical, systemic and supportive therapies.

**VSIO31-09**  
**Role of Aggressive Surgery in mNET**

Robert E. Roses MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Discuss the role of resection of a primary NET in the setting of metastatic disease. 2) Discuss the evidence for resection of metastatic NET 3) Discuss the management of complex patients with multiple sites of disease or bilobar liver metastases.

**ABSTRACT**

Neuroendocrine tumors include a diverse group of clinical and pathologic entities. Treatment priorities must be personalized and reflect spectrum of disease, symptoms and tumor biology. Notwithstanding, a convincing role for aggressive surgical management has emerged and can benefit patients with early and disseminated disease. Resection of the primary tumor is often indicated, even in the presence of metastases. Aggressive liver resection appears to be of benefit; particularly if all visible disease can be removed. For patients with disseminated disease a multidisciplinary approach and judicious application of interventional approaches is essential in achieving favorable outcomes.

**VSIO31-10**  
**Cone-Beam Computed Tomography Angiography for Depiction of Tumor-feeding Vessels during Chemoembolization of Malignant Liver Tumors: Comparison of Conventional and Dedicated-software Analysis**

Maxime Ronot MD (Presenter): Nothing to Disclose, Mohamed Abdel-Rehim MD: Nothing to Disclose, Viseth Kuoch MD: Nothing to Disclose, Antoine Hakime MD: Nothing to Disclose, Marion Roux :
PURPOSE

To compare the ability of a dedicated software and conventional cone beam computed tomography (CBCT) analysis to identify tumoral feeders in a series of malignant liver tumors treated with transarterial chemoembolization (TACE).

METHOD AND MATERIALS

Between January 2011 and January 2012, 66 hypervascular malignant liver tumors from patients who underwent TACE with contrast-enhanced CBCT at the arterial phase were included (51 HCC, 13 NET and 2 adrenal cancer metastases). Data were analyzed by 6 interventional radiologists blinded to each other analyses (2 junior and 4 experienced readers). Readers were asked to identify tumor feeders by performing 1) a conventional analysis using post-processing tools such as maximum intensity projection, multiplanar reconstruction, volume rendering, 2) a computer-aided analysis using FlightPlan for liver (referred to as raw-FPFL), and 3) a review of this computer aided analysis for which reader were asked to validate or invalidate each feeder detected by the software (referred to as reviewed-FPFL). Analyses were compared to a “Reference Reading” established by two study supervisors in consensus. Sensitivities, positive predictive values (PPV), and false positive ratios (FPR) were compared using Mac-Nemar, Chi-square and exact Fisher tests. Analysis durations were compared using a Mann-Whitney U test. Inter-readers agreements were assessed by mean of percentage of agreement.

RESULTS

A total of 179 feeding vessels were identified in the ‘Reference Reading’. The sensitivity of raw-FPFL was significantly higher than that of both reviewed-FPFL and conventional analyses (90.9% vs. 83.2% and 82.1%, p<0.0001), with lower PPV (82.9% vs. 91.2% and 90.6%, respectively (p<0.0001), higher FPR (17.1% vs. 9.4% and 8.8%, respectively (p<0.0001), and higher inter-reader agreement (92% vs. 80 and 79%, respectively, p<0.0001). The conventional analysis was significantly longer than that of both raw- and reviewed-FPFL (<0.0001).

CONCLUSION

Contrast-enhanced CBCT with software analysis enabled accurate and sensitive detection of tumor feeders of malignant liver tumors before TACE. The review of the software analysis was responsible for a significant decrease in the number of identified feeders.

CLINICAL RELEVANCE/APPLICATION

Dedicated software analysis of contrast-enhanced CBCT images should be used when performing transarterial chemoembolization of liver tumors.

VSIO31-11

Embolotherapy for mNET: When and How?

Sarah Beth White MD (Presenter): Consultant, Guerbet SA Consultant, Vascular Solutions, Inc Research support, Seimens AG

LEARNING OBJECTIVES

1) Assessment and triage of metastatic NETs. 2) Review of image guided therapies for mNETs. 3) Integration of systemic therapy with image guided therapies for mNETs.

ABSTRACT

Neuroendocrine tumors (NETs) describe a family of tumors that mainly arise from the gastrointestinal tract. The incidence is estimated to be between 2.5-5 per 100,000, two thirds of which are small intestine carcinoids. NETs can be clinically silent (unless hormone producing) and are often found incidentally. However, once they metastasize to the liver, the vasoactive substances they release can enter the systemic circulation and cause carcinoid syndrome, which clinically manifests as flushing and diarrhea. Treatment for metastatic NET (mNET) includes systemic therapies that range from monthly octreotide injections (a well-tolerated somatostatin analog) in mild cases to cytotoxic chemotherapies such as 5-FU and doxorubicin in aggressive cases. Embolotherapy has also started to play a role in the treatment of mNET; however, controversy still remains about which type of therapy is the most efficacious, bland embolization vs. conventional chemoembolization vs. drug eluting bead chemoembolization vs y-90 radioembolization. The objective of this session is to discuss the role of emblotherapy for the treatment of mNET and how to integrate it with systemic therapies.

VSIO31-12

Coming to America: PRRT

Daniel Pryma MD (Presenter): Research Grant, Siemens AG Research Grant, Molecular Insight Pharmaceuticals, Inc Speaker, IBA Molecular Advisory Board, Bayer AG

LEARNING OBJECTIVES

1) To understand the various available permutations of PRRT and their relative risks and benefits. 2) To appreciate the current research availability and potential for future availability of PRRT.

ABSTRACT
PRRT is a mainstay in the treatment of GEPNETS worldwide, but has very limited availability as an investigational therapeutic in the United States. The various permutations of radioisotopes and somatostatin analogs used for PRRT will be reviewed along with an understanding of their potential risks and benefits. The process of PRRT will be discussed including expectations for outcomes and toxicity. Finally, the availability of PRRT for American patients will be discussed.

**Liver-Directed Therapy for Metastases from Breast Cancer: Outcomes Analysis**

Amy Marie Fowler MD, PhD (Presenter): Nothing to Disclose, Stephanie Markovina MD, PhD: Nothing to Disclose, Angela Hirbe: Nothing to Disclose, Christina Koo Soeirs MD, PhD: Nothing to Disclose, Alejandro Munoz Del Rio PhD: Research Consultant, Cellectar Biosciences, Inc Reviewer, Wolters Kluwer nv, Todd DeWees: Nothing to Disclose, Cynthia Ma: Nothing to Disclose, Jeffrey R. Olsen MD: Consultant, DFINE, Inc Travel support, DFINE, Inc Speaker, ViewRay, Inc, Nael El Said Saad MBBCh: Research Consultant, Veran Medical Technologies, Inc Proctor, Sirtex Medical Ltd

**PURPOSE**

To determine the clinical outcomes for breast cancer patients with chemorefractory liver metastases treated with locoregional therapy.

**METHOD AND MATERIALS**

This HIPAA-compliant, IRB-approved study is a single-institution, retrospective chart review. Twenty-nine consecutive female breast cancer patients (mean age 55 years; 35-77) with unresectable liver metastases progressing despite systemic chemotherapy were included who were treated with radiofrequency (RF) ablation (n=7), chemoembolization (n=6), or 90Y radioembolization (n=16) from January 1999 to March 2013. Follow-up data was obtained through June 2013. Treatment response was evaluated on follow-up imaging which consisted of CT, MRI, and/or PET/CT. Overall survival (OS) time and time to progression (TTP) of disease was measured from the time of first liver-directed therapy. OS and TTP curves were generated using the Kaplan-Meier method and compared with the log rank test.

**RESULTS**

Median OS was 21 months (1-81 months) for all patients and was 34, 15.5, and 16 months for patients treated with RF ablation, chemoembolization, and radioembolization, respectively. Longer OS was measured for those treated with RF ablation compared to chemoembolization (p=0.04) or radioembolization (p=0.03). Median follow-up was 16 months (1-81 months) with one death from liver failure prior to follow-up imaging. Median TTP was 4 months (1-26 months) for all patients and was 2, 1, and 6 months for patients treated with RF ablation, chemoembolization, and radioembolization, respectively. Longer TTP was measured for patients treated with radioembolization compared to RF ablation (p=0.04).

**CONCLUSION**

Survival was comparable for patients treated with chemotherapeutic agents and radioembolization, but was prolonged for those treated with RF ablation, presumably from reduced pre-therapy disease burden.

**CLINICAL RELEVANCE/APPLICATION**

While this study is small with a heterogeneous retrospective cohort, the results support a palliative indication for radio- and chemoembolization with potential prolonged survival provided by RF ablation. Identification of patient and tumor biomarker criteria that best predict survival and consideration of earlier utilization of embolization at lower amounts of disease burden may improve outcomes. A matched-pair analysis with patients treated with systemic chemotherapy alone is in progress.

**LEARNING OBJECTIVES**

1) To present a variety of clinical scenarios highlighting the multidisciplinary options for management of liver metastases from neuroendocrine tumors through a 'tumor board' of experts representing each of the major oncologic disciplines.
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

**Hologic: Low-dose 3D Mammography for Breast Cancer Screening.**

**Vendor Workshops**  
**Tue, Dec 2 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.  
Please visit [www.hologic.com/RSNAtomo-courses](http://www.hologic.com/RSNAtomo-courses) to register for this Vendor Workshop.

**Samsung: First Experience of Samsung Premium Ultrasound System**

**Vendor Workshops**  
**Tue, Dec 2 2:30 PM - 3:00 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

**RCA34**

**Rapid Application Development with XIP™ - the eXtensible Imaging Platform (Hands-on)**

**Refresher/Informatics**

**AMA PRA Category 1 Credits ™: 1.50**

**ARRT Category A+ Credits: 1.50**

**Tue, Dec 2 2:30 PM - 4:00 PM  Location: S401AB**

**Participants**

- Lawrence R. Tarbox  PhD (Presenter): Nothing to Disclose
- Fred William Prior  PhD (Presenter): Research collaboration, Electrical Geodesics, Inc

**LEARNING OBJECTIVES**

1) Learn the basic architecture of an XIP™ Application and how it interacts with the XIP Host™ and with the GUI system. 2) Become familiar with the capabilities available in the XIP Libraries™. 3) Describe how to use the XIP Builder™ and GUI engine to create XIP Applications from modules in the XIP Libraries. 4) Understand the concepts of DICOM Application Hosting and its impact.

**ABSTRACT**

The eXtensible Imaging Platform (XIP™) is an open source framework supporting rapid development of imaging and visualization applications. In this ‘hands on’ tutorial participants will dissect a fully functional XIP™ application to see firsthand how developers utilize XIP’s visual ‘drag-and-drop’ programming tool (the XIP Builder™) and associated libraries (the XIP Libraries™) in creating applications. In addition to functions from the popular ITK and VTK libraries, the XIP Libraries include modules tailored for medical imaging, many of which are hardware accelerated via GPU programming (e.g., OpenGL® GLSL or OpenCL or CUDA C). Applications created with XIP can either run standalone, or as DICOM Hosted Applications. Through the DICOM Application Hosting interfaces (DICOM WG-23), a Hosting System, such as the XIP Host™, relieves the application developer from the need to re-implement infrastructure common to all applications (e.g. DICOM network connectivity, database, etc.). We will demonstrate how users execute Hosted Applications, such as those created with the XIP Libraries, via the XIP Host.

**URL’s**

- [http://www.OpenXIP.org](http://www.OpenXIP.org)

**RCB34**

**Making the Most of Google Docs: Collaborative Word Processors, Spreadsheets, and Calendars (Hands-on)**

**Refresher/Informatics**

**AMA PRA Category 1 Credits ™: 1.50**

**URL’s**

- [http://www.OpenXIP.org](http://www.OpenXIP.org)
Participants
Moderator
Marc D. Kohli MD: Research Grant, Koninklijke Philips NV Research Grant, Siemens AG

LEARNING OBJECTIVES
1) Describe the benefits and drawbacks of using google documents for collaborative editing. 2) Explain issues related to storing protected health information in google documents. 3) Demonstrate the ability to use google documents for collaboration on document and spreadsheet creation.

ABSTRACT
Note: Attendees should have or create a google account prior to coming to the session. In today's busy environment, we need tools to work smarter, not harder. Google documents provides a platform for collaboration that can be used across and within institutions to produce documents and work up data with less hassle. However, with increased sharing, security concerns need to be addressed. At the end of the session, learners should be able to demonstrate creating, sharing, and editing a document as a group.

Sub-Events

RCB34A Word Processor
Marc D. Kohli MD (Presenter): Research Grant, Koninklijke Philips NV Research Grant, Siemens AG

LEARNING OBJECTIVES
View learning objectives under main course title.

RCB34B Spreadsheet
Ross Warren Filice MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RCB34C Calendar
Aaron P. Kamer MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RCC34
Using IHE Profiles to Plan for Medical Imaging

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 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
Kinson Ho (Presenter): Employee, Agfa-Gevaert Group
David A. Clunie MBBS (Presenter): Owner, PixelMed Publishing LLC
Christopher Lindop (Presenter): Employee, General Electric Company

LEARNING OBJECTIVES
1) Value of IHE with content and vendor neutral integration. 2) How content neutral clinical information is managed with a Vendor Neutral Archive (VNA). 3) Planning for a Vendor Neutral Archive (VNA) or expand upon an existing VNA system to support both imaging and non-imaging content and systems. 4) The benefit of using IHE Imaging profiles for cross-enterprise and cross-community image sharing.

ABSTRACT
Integrating the Healthcare Enterprise (IHE) is a joint initiative of healthcare professionals and industry vendors to improve the way clinical systems in healthcare share information. IHE promotes the coordinated use of established standards such as webservices, DICOM and HL7 to address specific clinical need in support of optimal patient care. Established in 1997, the IHE Radiology Committee, a development domain of IHE, has profiled the clinical use cases to develop a framework of interoperability, known as the IHE Integration Profiles. Integration Profiles are developed specifically to be 'Vendor Neutral'. The first Integration Profile developed by IHE is known as Scheduled Workflow. It specifies how imaging departmental workflow can
operate seamlessly between vendors. The Integration Profiles are maintained and published by IHE in the IHE Technical Framework. With the introduction of Cross-Enterprise Document Sharing (XDS) in 2005, IHE has extended the definition of 'Neutral' to include non-imaging content storage in healthcare. This course will specifically deliver and review the IHE Integration Profiles developed by IHE Radiology and the other IHE domain committees profile which can be used by healthcare professionals and the industry for the interoperability specification, procurement and installation of a 'Content' Vendor Neutral Archive (VNA).

Hologic: Essentials of 3D Mammography Self-Guided Training

Vendor Workshops

Tue, Dec 2 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">www.hologic.com/RSNAtomo-courses</a> to register for this Vendor Workshop.

MSRO33

BOOST: Head and Neck—Case-based Review (An Interactive Session)

Multisession Courses

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AMA PRA Category 1 Credits™: 1.25
ARRT Category A+ Credits: 1.50

Tue, Dec 2 3:00 PM - 4:15 PM   Location: S103AB

Participants

Suresh K. Mukherji MD (Presenter): Nothing to Disclose
Sung Kim MD (Presenter): Nothing to Disclose
Carol R. Bradford MD (Presenter): Nothing to Disclose
Francis Paul Worden MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review common tumors of the head and neck. 2) Review imaging findings in head and neck malignancies that specifically change staging. 3) Review the value of imaging in directly affecting management and treatment.

ABSTRACT

This session will be tumor board that includes a head and neck radiologist, head and neck surgeon, medical oncologist and radiation oncologist. We will discuss a variety of head and neck cancer cases and illustrate the value-added benefits and highlight of imaging affects staging, treatment and management.

MSRO36

BOOST: Gynecology—Case-based Review (An Interactive Session)

Multisession Courses

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AMA PRA Category 1 Credits™: 1.25
ARRT Category A+ Credits: 1.50

Tue, Dec 2 3:00 PM - 4:15 PM   Location: S103CD

LEARNING OBJECTIVES

1) Present the multidisciplinary management of gynecologic cancers including surgery, radiation and chemotherapy. 2) Highlight the importance of diagnostic imaging before, during and after treatment. 3) Highlight the importance of imaging in the planning and delivery of radiation.

ABSTRACT

The care of patients with gynecologic cancers requires the collaboration of imaging specialists as well as gynecologic and radiation oncologists. Patterns of disease spread and recurrence have tremendous impact on the management of these patients, and diagnostic imaging is key in defining disease at diagnosis and following patients for detection of recurrence after treatment. Image-guided radiation is considered the standard of care for both the planning of external beam and brachytherapy and is key in maximizing the benefits of radiation while minimizing the risks. Case examples of the pivotal impact of imaging and its importance in multidisciplinary care will be highlighted in this session.

Sub-Events

MSRO36A Updates in PET/CT Imaging and New Horizons with PET/MRI in Gynecologic Oncology

Lale Kostakoglu MD, MPH (Presenter): Nothing to Disclose
SSJ01

Breast Imaging (Quantitative Imaging)

Sub-Events

SSJ01-01

3D Computer-Aided Detection (CAD) System for Breast Tomosynthesis in the Detection of Microcalcifications: Initial Experience

PURPOSE

To evaluate the performance of a 3D computer-aided detection (CAD) system for breast tomosynthesis (DBT) in the detection of microcalcifications in comparison with 2D CAD for digital mammography.

METHOD AND MATERIALS

3D CAD (ImageChecker 1.0, Hologic) and 2D CAD systems (R2 ImageChecker CAD 9.3, Hologic) were retrospectively applied to combined DBT-digital mammograms of 68 women (mean age, 51 years; range, 30-77 years) with 68 microcalcifications (31 malignant [14 invasive, 17 DCIS], 37 benign; BI-RADS category 2 in 19, category 3 in 2, category 4 in 31, and category 5 in 16). Number of DBT reconstructed slices obtained per breast ranged from 36 to 76 (mean, 56.7). CAD marks were considered positive if the location of the corresponding lesions were correctly identified on at least one slice of DBT or one view of digital mammograms. Sensitivities for malignancy and for recalled lesions were defined as the number of lesions correctly marked divided by the total number of malignant lesions and by the number of the BI-RADS category 3, 4, or 5 lesions, respectively. To evaluate the false-positive mark rate, 20 mammograms with no clinical or radiologic abnormalities during 2-year follow-up in 20 women were used. Differences between 3D and 2D CAD systems were compared by using McNemar test and Wilcoxon signed rank test.

RESULTS

Sensitivities of 3D CAD were similar to those of 2D CAD for both malignancies (97% [30/31] vs. 100% [31/31], P = 1.0) and recalled lesions (97% [48/49] vs. 100% [49/49], P = 1.0). 2D CAD correctly marked one additional cancer at one view, which was missed by 3D CAD. For the 20 normal mammograms, mean false-positive marks per view with 3D CAD was similar to that of 2D CAD (0.13 vs. 0.14, P = 0.48).

CONCLUSION

3D CAD for DBT achieved 97% sensitivities for both malignant and recalled microcalcifications with 0.13 false-positive marks per view, which was comparable to those of 2D CAD.

CLINICAL RELEVANCE/APPLICATION

3D CAD is expected to reduce the interpretation time for radiologists in the detection of suspicious microcalcifications in reconstructed DBT slices with high sensitivity and an acceptable false positive rate.
SSJ01-02  Prediction of False-positive Recall from Screening Mammography Using Computer-extracted Breast Tissue Complexity Features: Data from the ACRIN 4006 trial

Shonket Ray PhD (Presenter): Nothing to Disclose, Brad M. Keller PhD: Nothing to Disclose, Jae Young Choi DPhil: Nothing to Disclose, Jinbo Chen PhD: Nothing to Disclose, Emily F. Conant MD: Scientific Advisory Board, Hologic, Inc, Despina Kontos PhD: Nothing to Disclose

PURPOSE

To investigate the feasibility to predict risk of false-positive recall from breast cancer screening with digital mammography based on computer-extracted parenchymal pattern features of breast tissue complexity.

METHOD AND MATERIALS

Digital mammography (DM) images from the ACRIN 4006 trial were retrospectively analyzed. The trial was a reader study to compare screening call-back rates from 2D DM versus a combination of 2D/digital breast tomosynthesis (DBT) in an enriched cohort of women. A total of 550 women imaged, 76 were recalled on the basis of DM alone, from which 11 were true-positives. Images were acquired using a full-field digital mammography (FFDM) unit. All DM images sets consisted of bilateral CC and MLO views and were vendor post-processed (“For Presentation”, Selenia Hologic Inc.). To characterize breast tissue complexity, breast percent density (PD) was estimated on a per-woman basis using previously validated automated software. In addition, thirteen texture features were extracted using a locally adaptive computerized parenchymal texture analysis algorithm. Logistic regression was performed to identify significant predictors of overall recall and false-positive recall respectively, adjusting for age and number of previous benign biopsies. The area under the curve (AUC) of the receiver operating characteristic (ROC) was used to evaluate model performance.

RESULTS

The logistic regression model has AUC=0.75 (95% CI 0.69-0.81) for predicting overall recall from DM and AUC=0.94 (95% CI 0.87-0.99) for predicting risk of false-positive recall; outperforming prediction based on age and number of previous benign biopsies alone that have AUC=0.64 (95% CI 0.57-0.70) and AUC=0.73 (95% CI 0.51-0.94) respectively. Significant predictors (p<0.05) are energy, inertia, inverse difference moment, sum average, sum variance, difference average, difference variance and difference entropy. Sensitivity for predicting false-positive recalls is 80% at a 100% cancer detection ROC operating point.

CONCLUSION

Prediction of false-positive recall from DM screening mammography could be improved with the inclusion of computer-extracted features of breast tissue complexity.

CLINICAL RELEVANCE/APPLICATION

Prediction models could identify women at high-risk for false-positive DM screening due to their breast tissue complexity, who may be offered supplemental modalities for breast cancer screening.

SSJ01-03  Fully Automated Volumetric Breast Density Estimation from Digital Breast Tomosynthesis Images: Multi-modality Comparison with Digital Mammography and Breast MRI

Said Pertuz PhD (Presenter): Nothing to Disclose, Elizabeth McDonald MD, PhD: Nothing to Disclose, Susan Weinstein MD: Nothing to Disclose, Emily F. Conant MD: Scientific Advisory Board, Hologic, Inc, Despina Kontos PhD: Nothing to Disclose

PURPOSE

Accurate breast density estimation is important for breast cancer risk assessment and guiding personalized breast screening recommendations. We investigate the feasibility of fully-automated volumetric breast density estimation (VBD) from digital breast tomosynthesis (DBT), and compare to VBD estimates from digital mammography (DM) and breast MRI. Compared to 2D mammography, DBT visualizes the 3D distribution of fibroglandular tissue, having the potential to allow for more accurate VBD estimation.

METHOD AND MATERIALS

Bilateral DBT images, DM images (Selenia, Hologic Inc.) and sagittal MRI scans (GE LX echo speed, Siemens) were retrospectively collected from 63 women undergoing breast cancer screening within the course of one year (2010-11). A fully-automated algorithm was developed to segment the fibroglandular tissue and measure VBD from all DBT images. The proposed algorithm exploits the geometry of the acquisition of DBT sequences as well as the relationship between image intensity and tissue density and achieves 3D segmentation of the fibroglandular tissue by analyzing both the projection images and reconstructed DBT slices. For comparison, the DM images were processed with FDA-cleared software (Volpara 1.5, Matakina) and the MR images were processed with previously validated automated software to obtain corresponding VBD estimates. The Pearson’s correlation and linear regression were used to compare the obtained multi-modality VBD estimates.

RESULTS

Substantial agreement is observed between bilateral VBD estimates from DBT images (r = 0.89, 95% CI: 0.83-0.93, p<0.001). Estimates of the total breast volume and percent volumetric breast density from DBT are highly correlated with DM with r = 0.99 (95% CI: 0.98-0.99) and r = 0.88 (95% CI: 0.81-0.93); as well as with the MR-based estimates with r = 0.95 (95% CI: 0.91-0.96) and r = 0.76 (95% CI: 0.63-0.85), respectively (p<0.001). Corresponding correlations between DM and MRI are r = 0.95 (95% CI: 0.92-0.97) and r = 0.73 (95% CI: 0.59-0.83).
CONCLUSION

Fully-automated 3D fibroglandular tissue segmentation and VBD estimation from DBT images is feasible and shows strong agreement with existing volumetric techniques based on DM and MRI images.

CLINICAL RELEVANCE/APPLICATION

Fully-automated quantitative VBD estimation from DBT could result into more accurate measures of the fibroglandular tissue in the breast and ultimately more accurate measure of breast cancer risk.

Three-Compartment Breast Imaging and Quantitative Mammographic Image Analysis: Synergy for Improved Diagnosis


PURPOSE

To investigate whether knowledge of the biologic composition of breast lesions and the embedding parenchyma, derived through three-compartment breast (3CB) imaging, can improve upon existing mammographic quantitative image analysis (QIA) in estimating the probability of malignancy.

METHOD AND MATERIALS

3CB imaging is a novel imaging technique that derived biologic tissue composition measures from dual-energy mammography and a thickness phantom at about 110% of the dose of a regular mammogram. The study population consisted of 96 patients with 102 breast lesions imaged with dual-energy mammography prior to breast biopsy with final diagnosis resulting in 16 invasive ductal carcinomas, 10 ductal carcinoma in situ (DCIS), and 76 benign diagnoses. Analysis was three-fold: 1) The raw low-energy mammographic images were analyzed with an established in-house QIA method, ‘QIA alone’, 2) the 3-compartment breast (3CB) composition measure - derived from the dual-energy mammography - of water, lipid, and protein thickness were assessed, ‘3CB alone’), and 3) information from QIA and 3CB was combined, ‘QIA+3CB’. Analysis was initiated from radiologist-indicated lesion centers and was otherwise fully automated. Steps of the QIA and 3CB methods were lesion segmentation, characterization, and subsequent classification for malignancy in leave-one-case-out cross-validation. Performance was assessed using Receiver Operating Characteristic (ROC) analysis with the area under the ROC curve (AUC) as figure of merit.

RESULTS

The AUC for distinguishing between benign and malignant lesions (invasive and DCIS) was 0.78 (standard error 0.06) for the ‘QIA alone’ method, 0.66 (0.06) for ‘3CB alone’ method, and improved to 0.85 (0.05) for ‘QIA+3CB’ combined (p=0.05 with respect to ‘QIA alone’).

CONCLUSION

Combining knowledge of the composition of breast lesions and their periphery with an existing mammographic QIA method improved the distinction between benign and malignant lesions, which could help prevent unnecessary biopsies and improve diagnostic decision making.

CLINICAL RELEVANCE/APPLICATION

Three-Compartment Breast Imaging quantitatively assesses tissue composition of breast lesions and parenchyma and yields information largely independent from what can be gleaned from mammography alone, which could help increase biopsy yield while reducing unnecessary biopsies.

Classification of Breast Cancer Subtypes Using MRI Texture Features

Elizabeth J. Sutton MD (Presenter): Nothing to Disclose, Brittany Dashevsky MD, DPhil: Nothing to Disclose, Jung Hun Oh PhD: Nothing to Disclose, Harini Veeraraghavan: Nothing to Disclose, Elizabeth A. Morris MD: Nothing to Disclose, Joseph Owen Deasy PhD: Nothing to Disclose, Aditya Prakash Apte PhD: Nothing to Disclose, Girard Gibbons BA: Nothing to Disclose

PURPOSE

Breast cancer subtypes have been classified based on tumor genotype variation and are indicators of disease free and overall survival. Using texture features extracted from magnetic resonance imaging (MRI) and a machine learning method, we investigated whether imaging characteristics could differentiate breast cancer subtypes.

METHOD AND MATERIALS
This retrospective study received institutional review board approval and need for informed consent waived. 178 women with invasive ductal carcinoma (IDC) and preoperative breast MRI were identified. Immunohistochemistry surrogates defined subtypes, and the distribution was: estrogen and progesterone receptor positive (ERPR+; n=95, 53.4%), HER2 receptor positive (HER2+; n=35, 19.6%) and triple negative (TN; n=48, 27.0%). Clinical and pathologic data were collected. Tumors were contoured on the fat-suppressed T1-weight pre- and three post-contrast images. Shape-, texture- and histogram-based features were extracted using in-house software (Computational Environment for Radiological Research). Support vector machine (SVM), a frequently used machine learning technique for classification problems, was used to identify significant image features and build a robust model to predict each IDC subtype.

RESULTS

SVM identified significant clinical, pathologic and imaging features. When the top 9 features were incorporated, the predictive model distinguished IDC subtypes with an overall accuracy of 83.4%. The model's accuracy for each subtype was 89.2% (ERPR+), 63.6% (HER2+) and 82.5% (TN). The nine features were: nuclear grade, tumor volume, presence of multi-centric disease, three texture features, and three histogram-based features. For these features, statistical analysis was performed using Kruskal-Wallis test. For all the 9 features, there was a statistically significant difference between ERPR+, HER2+ and TN subtypes with p < 0.0001.

CONCLUSION

We have developed a machine-learning-based predictive model using texture features extracted from MRI that can distinguish IDC subtypes with significant predictive power.

CLINICAL RELEVANCE/APPLICATION

We were able to leverage computer-derived MRI phenotypic image-based biomarkers that reflect the genetic variability of different breast cancer subtypes, which are associated with different outcomes.

SSJ01-06

Relationship of Quantitative MRI-based Phenotypes and the Molecular Classifications of Breast Cancers in the TCGA/TCIA Dataset


PURPOSE

To investigate the performance of MRI-based phenotypes in predicting the molecular classification of breast cancers in The Cancer Genome Atlas dataset of NCI.

METHOD AND MATERIALS

Quantitative image analysis was performed on 98 de-identified, MRI studies depicting biopsy-proven breast cancers MRI studies from the NCI’s multi-institutional The Cancer Imaging Archive and The Cancer Genome Atlas project. Immunohistochemistry molecular classification determined estrogen (ER+82/ER-16), progesterone (PR+75/PR-23) and HER2 (HER2+16/HER2-16) receptor status for each case. Computerized image-based phenotyping included: 1) 3D lesion segmentation based on a fuzzy c-means clustering algorithm; 2) computerized feature extraction; 3) leave-one-out linear stepwise feature selection; and 4) Linear Discriminant Analysis (LDA) as the prognostic predictive classifier. The performance of the classifier model for molecular subtyping was evaluated using jackknifing ROC analysis with area under the ROC curve (AUC) as the figure of merit.

RESULTS

Use of computer-extracted tumor phenotypes in for the task of distinguishing between molecular prognostic indicators, yielded AUC values of 0.79 (p-value < 0.0001), 0.68 (p-value = 0.0066), and 0.61 (p-value =0.126) in the tasks of distinguishing ER- vs ER+, PR- vs PR+, and HER2- vs HER2+, respectively. Features selected for the predictive tasks included volumetrics, texture (entropy), and kinetics for the predictive tasks.

CONCLUSION

The results from this study indicate that quantitative MRI analysis shows promise as a means for high-throughput image-based phenotyping in the discrimination of breast cancer subtypes, and potential. Merging imaging phenotypes with genomic data may lead to improved prognostic predictors.

CLINICAL RELEVANCE/APPLICATION

Computerized image-based phenotyping may yield quantitative predictive models of breast cancer for precision medicine.
Breast Imaging Keynote Speaker: Contrast Mammography
John Morton Lewin MD (Presenter): Research Consultant, Hologic, Inc Scientific Advisory Board, Hologic, Inc Research Grant, Hologic, Inc

Clinical Help of Enhancement by Dual Energy Contrast-enhanced Spectral Mammography on Impalpable Breast Microcalcifications
Yun-Chung Cheung MD (Presenter): Nothing to Disclose, Yu-Ching Lin MD: Nothing to Disclose, Shir-Hwa Ueng: Nothing to Disclose, Hsiu-Pei Tsai: Nothing to Disclose, Yung-Feng Lo MD: Nothing to Disclose

PURPOSE
Mammographic impalpable microcalcifications have various probabilities of cancers. This retrospective study was to evaluate the help of enhancement by Dual Energy Contrast-Enhanced Spectral Mammography (DE-CESM) clinically on the concern impalpable breast microcalcifications

METHOD AND MATERIALS
Reviewed 256 DE-CESM examinations from 2012 to 2013, 59 sites of pathologic proved impalpable microcalcifications in 52 women (ranged from 30 y/o to 69 y/o, average 48.9 y/o) were enrolled in this study. All the microcalcifications were classified to ACR-BIRADS 4. The DE-CESM was performed standardized with craniocaudal and mediolateral oblique views of bilateral breasts 2 minutes after bolus injection of iodinated contrast medium. The diagnostic profiles for sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated. The enhanced appearances and sizes of cancers were reviewed.

RESULTS
Twenty-two microcalcifications (37.3%) were histologic diagnosed to cancers (16 Ductal Carcinoma In Situ (DCIS), 6 Invasive Ductal Carcinoma (IDC)); 19 (32.2%) were atypia lesions (6 Atypical Ductal Hyperplasia, 13 Flat Epithelial Atypia) and 18 (30.5%) were benign. Enhancement was revealed at 27 microcalcifications including 6 IDC (100% of IDC), 14 DCIS (87.5% of DCIS), 4 atypia (21%) and 3 benign lesions (16.7%). However, 2 low grade DCIS were not enhanced. The enhanced cancers appeared as masses in 5, regional in 6, segmental in 4, clump (cluster of foci) in 3 and foci in 2. The diagnosis of enhancement on DE-CESM were 90.9% in sensitivity, 81.1% in specificity, 74% in positive predictive value, 93.75% in negative predictive value and 84.7% in accuracy. The average size of 18 operated cancers was 1.77 cm on subtracted mammograms that was close to 1.72 cm on microscopy.

CONCLUSION
DE-CESM provides additional information of associate enhancement in diagnosing the impalpable breast microcalcifications, not-perfectly with acceptable sensitivity or negative predictive value. The sizes of enhanced cancers closely related to microscopic size that would help for pre-operative planning.

CLINICAL RELEVANCE/APPLICATION
DE-CESM can evaluate if the concern microcalcifications associating with enhancement and this information helps for diagnosis or surgery planning.
To compare the low energy image (LE) of CESM only to mammography (MG) regarding diagnostic accuracy of histologically proven breast lesions.

**METHOD AND MATERIALS**

The study was approved by Health Authorities and Ethics Committee. 90 consenting patients diagnosed with breast cancer were imaged with MG and CESM and underwent surgery. 136 malignant and 15 benign lesions could be assessed. CESM was performed as a bi-lateral examination starting 2 minutes after injection of an iodinated contrast agent. LE and MG images were interpreted by three blinded independent radiologists with an interval of minimum 4 weeks for memory wash-out. Sensitivity and specificity were evaluated across readers. BI-RADS 4 was defined as threshold for true positives. Gold standard was post-surgical histology.

**RESULTS**

Sensitivity with LE was 47.0% for reader1, 43.7% for reader2 and 33.8% for reader 3 (average 41.5%) and 47%, 45% and 39.7% (average 43.9%) with MG, respectively. Specificity was 86.7% (readers 1 and 3) and 80% (reader 2) for LE in average 84.4%, 100% (readers 1 and 2) and 97.8% (reader3) in average 94.8% for MG. The differences were not significant. There was no significant difference in sensitivity and a slightly higher average specificity in MG (p=.03).

**CONCLUSION**

The LE-image of CESM and MG showed similar sensitivity and MG had a slightly higher specificity than the LE only.

**CLINICAL RELEVANCE/APPLICATION**

CESM is a reliable imaging technique with superior diagnostic accuracy, which may replace MG in symptomatic patients to avoid unnecessary radiation. To do so it is important to know, if the diagnostic information of the LE images is comparable to MG.

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**Dose Evaluation of Contrast-enhanced Spectral Mammography in a National Cancer Centre**

Jennifer Murphy MBCh, MRCPI (Presenter): Nothing to Disclose, Siobhan O’ Neill MBCh : Nothing to Disclose, Fiachra Gerard Moloney MBCh, MRCPI : Nothing to Disclose, Lorna Duddy MD : Nothing to Disclose, Nina Louise Marshall MBBS : Nothing to Disclose, Josephine Barry MBCh, FRCR : Nothing to Disclose, Max Frederick Ryan MBCh : Nothing to Disclose

**PURPOSE**

The aim of this study is to evaluate the dose associated with contrast-enhanced spectral mammography (CESM) compared with full field digital mammography (FFDM) in a national breast cancer centre using web-based radiation dose tracking software and to investigate factors that affect this.

**METHOD AND MATERIALS**

Fifty patients attending the Symptomatic Breast Clinic who underwent FFDM and CESM within a short interval were retrospectively identified. Average glandular dose (AGD) was calculated for FFDM, low energy CESM (LE-CESM) and high-energy CESM (HE-CESM). Compressed breast thickness was recorded. Breast density was measured using the American College of Radiology (ACR) Breast Imaging-Reporting and Data System (Bi-RADS) by two independent radiologists.

**RESULTS**

Fifty patients were included in the study (all female, mean age 54.3 ±13.2 years). The mean AGD for FFDM, LE-CESM and HE-CESM was 5.39 mGy, 7.78 mGy and 1.87 mGy respectively. LE-CESM was associated with a significantly higher dose than FFDM (mean difference 2.39 mGy, CI 1.82 - 2.96, p

**CONCLUSION**

CESM is a relatively novel technique. Studies have shown that it has a higher sensitivity for breast cancer than FFDM and better specificity than MRI. It is associated with increased dose when compared to FFDM however remains within accepted limits set out in ACR guidelines.

**CLINICAL RELEVANCE/APPLICATION**

As LE-CESM is technically equivalent to FFDM, CESM could be used instead of FFDM to reduce overall dose in selected patients.

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**Challenges in Dual-energy Contrast Enhanced Spectral Mammography: Artifacts**

Yael Yagil MD (Presenter): Employee, Neopharm Group, Annat Shalmon MD : Nothing to Disclose, Arie Rudnstein MD : Nothing to Disclose, Yael Servadio MD : Nothing to Disclose, Osnat Halshtok MD : Nothing to Disclose, Michael Gotlieb MD : Nothing to Disclose, Miriam Sklair-Levy MD : Nothing to Disclose

**PURPOSE**

The use of contrast-enhanced spectral mammography (CESM) is on the rise, however the literature on image artifacts is sparse. The goal is to review and describe the incidence of commonly encountered artifacts in CESM.

**METHOD AND MATERIALS**

Included in this retrospective study were women who underwent CESM for screening and diagnostic purposes. Data recorded included patient age, medical history and relevant clinical information. CESM was performed using a full-field digital mammography system with software and hardware modifications enabling acquisition and
image post processing of dual-energy exposures. Acquisition parameters collected included mAS, kV, compression force, breast thickness, compression plate size. Images were reviewed with focus on the presence of artifacts on recombined images: rim enhancement (breast within breast), skin line enhancement, ripple like appearance, focal dot enhancement, linear horizontal line through the axilla, and silhouette sign. Statistical analysis was performed using Chi-Square Test and T-Test.

RESULTS

Included in the study were 105 women, average age 50 years (27-74 yrs), 13 (12%) with familial predisposition and 28 (27%) with prior history of breast malignancy. Indications for the CESM were screening in 53 (50%) cases, breast tenderness or palpable lesion in 29 (28%), disease extent evaluation in 11 (10%), and pre-op FNCL in 3 (3%). Average mammography density BIRADS score was 3. Average CESM parameters were 85 mAS, 79 dN compression and 58 mm breast thickness. 99% of women had at least one artifact detected on recombined images: 103 (98%) rim enhancement, 44 (42%) skin line enhancement, 93 (89%) ripple-like appearance, 4 (4%) dot enhancement, 62 (59%) axillary horizontal line and 11 (10.5%) silhouette sign. Statistical significance was found between skin line enhancement and silhouette sign, and Silhouette sign with 42mAS on low-energy images (p-value<0.001). Axillary line was detected bilaterally in all cases, and associated in 98% with the use of a small compression plate (1914x2294x12mm).

CONCLUSION

Image artifacts are common on CESM studies. Therefore it is crucial to interpret them correctly and prevent misinterpretation of the artifacts as real breast pathology.

CLINICAL RELEVANCE/APPLICATION

Recognition and identification of artifacts seen on CESM are crucial for improved quality of mammographic interpretation and prevent characterization of artifacts as real breast pathology.
RESULTS
There was strong consistency between aortic flow and pulmonary flow measurements obtained at the pulmonary valve or as the sum of the branch pulmonary arteries ($\rho=0.93, 0.90$). Differential pulmonary flow measurements obtained from 4D-PC and NPS largely agreed ($p=0.92$), while correlation between 2D-PC and NPS was more modest ($p=0.74$). MRI and NPS were better matched among patients without substantial pulmonary regurgitation (RF<20%, $n=15$) whether obtained by 4D-PC ($p=0.97$) or 2D-PC ($p=0.94$). In contrast, the presence of substantial pulmonary regurgitation (RF≥20%, $n=11$) more severely impacted the accuracy of 2D-PC ($p=0.47$) than 4D-PC ($p=0.89$).

CONCLUSION
Highly-accelerated 4D-PC may not only help simplify congenital cardiac MRI, but may obviate the need for a separate nuclear scintigraphic examination to confirm differential pulmonary perfusion.

CLINICAL RELEVANCE/APPLICATION
The use of highly-accelerated 4D-PC as part of a congenital cardiac MRI may obviate the need for a separate nuclear scintigraphic examination to quantify differential pulmonary perfusion.

SSJ03-02
Utility of a Novel High Resolution 3D MRI Sequence [SPACE] for Evaluation of Congenital Heart Disease

PURPOSE
The purpose of this study was to evaluate the role of a high-resolution 3D dark blood turbo spine echo sequence with variable flip angles (SPACE) in evaluation of congenital heart disease.

METHOD AND MATERIALS
SPACE sequence was performed in 20 patients (mean age, 17.6 ± 12.6 years, range: 9 month - 57 years) with either unrepaired (N=3) or post repair (n=17) congenital heart disease. There were 13 males and 7 females; 10 patients with tetralogy of Fallot, 3 with transposition of great arteries and 7 other complex CHD. All scans were performed on 1.5T Aera Siemens scanners. Two separate observers with expertise in cardiovascular imaging scored the quality of the images for blood suppression and definition of key anatomical structures in a blinded fashion. A five grade scoring system was developed with score 1 being non-diagnostic and 5 being excellent quality diagnostic information.

RESULTS
Mean of average overall quality scores for two observers was 4 ± 0.62. All overall quality scores were greater than 3. None of the studies were deemed nondiagnostic. Mean length of the SPACE acquisition time was 12.7 mins (4 - 21 mins). Typical matrix size, FOV, and slice thickness were 320 x 240, 30 x 40 cm and 1.3-1.5 mm respectively. There was no significant correlation between image quality and duration of scans. Ability of SPACE for defining borders of larger anatomical structures such as ventricles was better with mean score of 4.2 ± 0.54 compared to smaller structures, such as left main coronary artery with score of 2.1 ± 1.3 (p value <.0001). Lack of blood suppression was the limiting factor in image quality with the most common place being ascending aorta in 9 patients. However, overall blood suppression score was very good with score of 3.9 ± 0.43. There were no differences in image quality for patients under anesthesia compared to conscious patients. There was a positive correlation between the readers in overall scoring of the studies ($r = 0.67$, $p: .0012$).

CONCLUSION
The 3D SPACE dark blood sequence with near isotropic spatial resolution coupled with respiratory and cardiac gating can be feasibly performed in all age group with diagnostic image quality in all cases in this study.

CLINICAL RELEVANCE/APPLICATION
SPACE can be used as a one-stop shop for evaluation of cardiac anatomy without contrast in complex congenital heart disease and post repair changes with superb image quality and definition.

SSJ03-03
Quantification and Mapping of Anomalous Pulmonary Venous Flow with Highly-accelerated 4D Phase-contrast MRI and Real-time Interactive Streamline Rendering
Albert Hsiao MD, PhD (Presenter): Founder, Morpheus Imaging, Inc Consultant, Morpheus Imaging, Inc, Ufrah Yousaf : Nothing to Disclose, Marcus T. Alley PhD : Nothing to Disclose, Frandics Pak Chan MD, PhD : Nothing to Disclose, Beverly Mansfield Newman MD, MBBC : Nothing to Disclose, Shreyas Shreenivas Vasanawala MD, PhD : Research collaboration, General Electric Company Stockholder, Morpheus Imaging, Inc

PURPOSE
Cardiac MRI is routinely performed for morphologic characterization and quantification of pulmonary-to-systemic shunting in patients with anomalous pulmonary veins, but can be labor-intensive to perform. Highly-accelerated, compressed-sensing parallel-imaging 4D phase-contrast MRI (4D-PC) is an emerging MRI technique, but has lacked software for analysis and quantification of complex pulmonary venous flow. Furthermore, it is yet unclear whether pulmonary venous and shunt flow can be reliably measured from 4D-PC data.

METHOD AND MATERIALS
With IRB approval and HIPAA-compliance, we retrospectively identified all patients with anomalous pulmonary veins who underwent quantitative cardiac MRI with 4D-PC between April, 2011 and October, 2013. 14 exams were identified (9 male, 5 female). 6 were performed at 1.5T and 8 at 3T after single-dose gadofosveset intravenous contrast. Algorithms for real-time interactive streamline visualization were integrated into in-house software. Blood flow was quantified at the outflow valves, branch pulmonary arteries, cavae, pulmonary veins, and any ASD or VSD. Pulmonary veins were mapped to their receiving atrial chamber with streamlines. The intraobserver, interobserver, and internal consistency of flow measurements were then evaluated with Pearson correlation and Bland-Altman analysis.

RESULTS
Mean acquisition time was shorter at 3T (5 min) than at 1.5T (9 min), due to higher acceleration factors possible at 3T (6-8 fold versus 4-fold). Among triplicate measurements, the coefficient of variation was smallest at the aortic and pulmonary valves (4-5%), moderate in the branch pulmonary arteries (18%) and greatest at the IVC (27%). These largely agreed with single measurements from a second observer ($p = 0.891-0.999$) depending on location and complexity of anatomy. After pulmonary veins were assigned to their receiving atrial chambers, direct measurements of shunt volume from anomalous veins and intracardiac shunts matched indirect estimates from the outflow valves ($p = 0.966$).

CONCLUSION
With streamline venous mapping, 4D-PC MRI can provide detailed and quantitatively consistent delineation of anomalous pulmonary veins and shunt flow.

CLINICAL RELEVANCE/APPLICATION
By providing a comprehensive quantitative view of extracardiac and intracardiac flow, highly-accelerated 4D-PC may be a time-efficient alternative to conventional planar MRI for patients with complex venous flow.

SSJ03-04
Quantitative Analysis of Myocardial Fibrosis Assessed by Cardiac Magnetic Resonance in Repaired Tetralogy of Fallot: Correlation between Late Gadolinium Enhancement Amount and Clinical/Functional Data

Vincenzo Noce MD (Presenter): Nothing to Disclose, Nicola Galea MD: Nothing to Disclose, Andrea Fiorelli: Nothing to Disclose, Riccardo Rosati: Nothing to Disclose, Valentina Sorrentino: Nothing to Disclose, Marco Francone MD: Speakers Bureau, Bracco nv, Iacopo Carbone MD: Nothing to Disclose, Carlo Catalano MD: Nothing to Disclose

PURPOSE
To evaluate relationships between myocardial fibrosis amount, assessed by quantitative analysis of late gadolinium enhancement (LGE) on cardiac magnetic resonance (CMR), functional values assessed by MRI measurements and clinical data in a population of patients who underwent primary Tetralogy of Fallot repair (rToF).

METHOD AND MATERIALS
We retrospectively evaluated by CMR nineteen patients with rToF, assessing clinical status at the time of MRI scan (NYHA class, exercise tolerance, history of documented clinical arrhythmias and syncope). CMR protocol comprehended biventricular functional evaluation on Steady-state free-precession (SSFP) obtaining volumes, ejection fraction (EF), cardiac output, myocardial mass and filling/ejection rates for both left and right ventricles (LV, RV), in addition LGE amount after Gadolinium administration was assessed on T1-weighted images.

RESULTS
LGE was detected in 14/19 patients, localized in RV insertions points (8/14), right ventricle outflow tract (5/14) and in the RV trabeculations (2/14). Mean LGE amount was of 2.17±0.73%, standardized by myocardial mass. Study cohort was sub-divided in LGE-positive and LGE-negative groups for statistical analysis (difference between means assessed with T-student and Wilcoxon tests; correlation assessed through Pearson and Spearman coefficients). We encountered a significant correlation between LGE amount, a reduced RV ejection fraction (48.3±8.2%, $p<0.05$).

CONCLUSION
Myocardial damage after ToF repair is frequent and is quantitatively assessable through CMR-LGE. In our population, LGE amount demonstrated a significant correlation with impairment of RV functional indexes and clinical data.

CLINICAL RELEVANCE/APPLICATION
CMR-LGE in rToF patients correlates with a worse functional-clinical status, thus it could represent a sensible follow-up tool after surgical repair.

SSJ03-05
Cardiothoracic CT and MR Guide Management in a Diverse Multi-Ethnic Cohort of Adults with Tetralogy of Fallot

Francisco Contreras BS (Presenter): Nothing to Disclose, Nishant D. Parekh MD: Nothing to Disclose, Jeffrey Michael Levsky MD, PhD: Nothing to Disclose, Nadine Chouietier: Nothing to Disclose, Linda Broyde Haramati MD, MS: Investor, OrthoSpace Ltd, Investor, Kryon Systems Ltd, Spouse, Board Member, Bio Protect Ltd, Spouse, Board Member, OrthoSpace Ltd, Spouse, Board Member, Kryon Systems Ltd

PURPOSE
To systematically examine if and how cardiothoracic CT and MRI guided management in a consecutive cohort of adults with tetralogy of Fallot (TOF) over a 10-year period at our urban, inner-city academic medical center.

METHOD AND MATERIALS

56 consecutive adults (30 men, mean age 35.26, range 18-69 years) with TOF at our inner-city academic medical center who underwent cardiothoracic imaging with CT or MRI were retrospectively identified by searching the radiology database 1/03-1/13. 77% (36/47) of patients with documented ethnicity were minorities: Black (19), multiracial (14), Asian (3). Medical charts were reviewed for surgical history, clinical presentation, indication for imaging, diagnoses and management. 84% (47/56) had one or more remote prior cardiac surgeries including transannular patch (30), infundibuloplasty (24), right ventricle to pulmonary artery conduit (13) and Blalock-Taussig shunt (6). 13% (7/56) died during the follow-up period.

RESULTS

21 patients underwent chest CT for symptoms including chest pain, dyspnea, hemoptysis and cough. 35 patients underwent cardiac MRI to evaluate ventricular volumes and function, pulmonary regurgitation and pulmonary artery flow. Imaging guided treatment in 66% (37/56) and did not alter management in the remaining 34% (19/56). Of these, 57% (21/37) underwent open or minimally-invasive surgery and 43% (16/37) received medical management. The most common surgical interventions were pulmonary valve replacement 33% (7/21) and right ventricle to pulmonary artery conduit revision 24% (5/21) for increased right ventricular volumes and worsening clinical symptoms. Medical therapy included treatment for heart failure in 75% (12/16) and pneumonia in 25% (4/16).

CONCLUSION

Cardiothoracic CT and MR imaging were valuable in guiding treatment in a multi-ethnic, diverse, inner-city cohort of adults with TOF, impacting surgical decision-making and medical management.

CLINICAL RELEVANCE/APPLICATION

Management of a multi-ethnic diverse group of adults with TOF was guided by chest CT and cardiac MR.

SSJ03-06

Cardiac Keynote Speaker: Imaging Repaired Tetralogy of Fallot—Current Practice and Future Developments

Frändics Pak Chan MD, PhD (Presenter): Nothing to Disclose

Abstract

Tetralogy of Fallot (TOF) is the most common cyanotic heart disease, representing 10% of all cases of congenital heart disease. The most frequent and important clinical indication for cardiac MRI in patient with TOF is the evaluation of impending right heart failure after total surgical repair. In young patients, total repair of TOF calls for closure of the ventricular septal defect and relief of the subvalvular, valvular, supravalvular pulmonary stenosis, the latter often accomplished with transannular patch augmentation. This leaves a varying degree of pulmonary regurgitation. While most patients tolerate the additional volume load to the right ventricle, about 10% of these patients progress to right-heart failure, necessitating surgical or transcatheter pulmonary valve replacement. Since all artificial valves have limited longevity and once placed they will likely require future replacement, this operation is ideally done just before irreversible RV failure. In current clinical practice, this event is estimated by ventricular sizes and ejection fractions. Cardiac MRI provides the most accurate measurements of these markers. The precise thresholds for these markers are being investigated by ongoing clinical studies.

Despite the demonstrated utility of cardiac MRI and the clinical needs to follow an increasing number of patients with repaired TOF, the availability of high-quality MRI study remains limited outside academic centers. The reasons may be traced to the high cost, the length, and complexity of the examination. These limitations are workflow related and may be ameliorated by volumetric acquisition of anatomic and flow information with 4D phase-contrast (4DPC) imaging technique. In the past few years, the performance of 4DPC in terms of acquisition time, temporal resolution, and image quality have improved significantly. Versions of 4DPC are being implemented by scanner manufacturers. User friendly, efficient software programs are becoming available for visualization and quantitative analysis of the 4DPC image data. Deployment of these technologies facilitates cardiac MRI study of patients with congenital heart disease, including TOF.
**Sub-Events**

**SSJ04-01**

**Comprehensive Assessment of Coronary Artery Disease by X-ray Phase-Contrast Computed Tomography**

Holger Hetterich MD (Presenter): Nothing to Disclose, Marian Willner: Nothing to Disclose, Julia Herzen: Nothing to Disclose, Christopher Habel: Nothing to Disclose, Alexander Christian Hipp: Nothing to Disclose, Fabian Bamberg MD, MPH: Speakers Bureau, Bayer AG, Siemens AG, Tobias Saam MD: Research Grant, Diamed Medizintechnik GmbH Research Grant, Bayer AG, Maximilian F. Reiser MD: Nothing to Disclose, Franz Pfeiffer: Nothing to Disclose

**PURPOSE**

Current clinical X-ray imaging technologies rely on absorption information only despite other contrast mechanisms that may provide complementary information. X-ray phase-contrast computed tomography (PCT) has demonstrated superior contrast in low absorbing materials like biological soft tissue. We hypothesized that PCT has the potential for comprehensive, improved assessment and characterization of coronary plaque in an experimental ex-vivo setting examining human coronary artery specimens using histopathology as standard of reference.

**METHOD AND MATERIALS**

Experiments were carried out at a laboratory-based set up consisting of X-ray tube (35kV), grating-interferometer and detector. Tomographic absorption and phase-shift images were reconstructed with an effective pixel size of 100 µm. PCT data was evaluated by reviewers blinded to histopathology. Sensitivity, specificity and accuracy for the detection of fibrous (FIB), lipid-rich (LIP) and calcified (CAL) tissue as well as signal intensities quantified by phase-contrast Hounsfield units (HU) were determined. Lumen, plaque and vessel area were obtained and compared to histopathology measurements.

**RESULTS**

Fifteen coronary arteries with 316 corresponding PCT and histopathology cross-sections were evaluated. Histopathology showed LIP in 30.7%, FIB in 82.9% and CAL in 56.0% segments. Plaque components were detected with a sensitivity of ≥95.9%, specificity of ≥94.5%, positive and negative predictive value of ≥88.6% and ≥94.7%, respectively. Inter-rater agreement was high with κ≥0.91. HUp were significantly different for all tissue types with 39.9±16.8 for LIP, 61.7 ± 54.6 for FIB and 447.3 ± 437.9 for CAL (p<0.001). Receiver operating characteristic curves for the differentiation of FIB and LIP demonstrated an area under the curve of 0.87 for HUp and 0.77 for conventional HU (p<0.001). PCT showed a good correlation with histopathology in lumen, vessel and plaque area measurements with a Pearson’s R of ≥0.86.

**CONCLUSION**

PCT allows comprehensive and accurate assessment of coronary atherosclerosis in an ex-vivo setting. Future studies will determine its feasibility for in-vivo applications.

**CLINICAL RELEVANCE/APPLICATION**

Currently PCT might serve as a non-destructive method for accurate ex-vivo assessment of coronary plaque in cardiovascular research.

**SSJ04-02**

**Image Quality and Radiation Dose of Low Tube Voltage Third Generation Dual-Source Coronary CT Angiography in Obese Patients: A Phantom Study**

Stefan Baumann MD: Nothing to Disclose, Felix G. Meinel MD (Presenter): Nothing to Disclose, Christian Canstein: Employee, Siemens AG, Martin Ulrich Sedlmair MS: Employee, Siemens AG, Carlo Nicola de Cecco MD: Nothing to Disclose, U. Joseph Schoepf MD: Research Grant, Bracco Group Research Grant, Bayer AG Research Grant, General Electric Company Research Grant, Siemens AG, Bernhard Schmidt PhD: Employee, Siemens AG, Brett S. Harris PhD: Nothing to Disclose, Thomas G. Flohr PhD: Employee, Siemens AG

**PURPOSE**

To assess the influence of tube potential on radiation dose and image quality at 3rd generation dual-source coronary CT angiography (CTA) in a phantom model simulating an obese patient.

**METHOD AND MATERIALS**

A thoracic phantom was equipped with tubular inserts containing iodine solution and water. A soft tissue-equivalent ring around the phantom simulated an obese patient. Images were acquired at tube potentials of 80, 100, 120, and 140 kV with 2nd generation dual-source CT (DSCT) and 70-150 kV (in 10 kV increments) with 3rd generation DSCT. Contrast-to-noise ratio (CNR) was calculated and CT dose index was recorded.

**RESULTS**

With 2nd generation DSCT, iodine attenuation decreased from 667 ± 4 HU at 80 kV to 315 ± 3 HU at 140 kV and image noise decreased from 56 ± 4 HU at 80 kV to 18 ± 1 HU at 140 kV. With 2nd generation DSCT, CNR
was highest for 120 kV (19.0) and decreased with lower tube potential (12.0 at 80 kV) due to disproportionately increased image noise. With 3rd generation DSCT, iodine attenuation decreased from 782 ± 9 HU at 70 kV to 309 ± 4 HU at 150 kV and image noise decreased from 37 ± 4 HU at 70 kV to 17 ± 2 HU at 150 kV. With 3rd generation DSCT, 70 and 80 kV acquisitions showed a smaller increase in noise. CNRs for 3rd generation DSCT were highest for 70 and 80 kV (21.1 and 21.2, respectively). Compared to 120 kV, radiation dose was 68 % and 49 % lower at 70 kV and 80 kV, respectively.

CONCLUSION

Our phantom experiments indicate that the high tube power of 3rd generation DSCT can prevent the disproportionate increase in image noise, which has so far precluded the use of low tube potential CTA in obese patients. Third generation DSCT may enable performing coronary CTA at 70-80 kV in obese patients without compromising subjective and objective image quality. Compared to 120 kV, which is the currently the clinical standard for obese patients, this approach reduces radiation dose by 49-68 %.

CLINICAL RELEVANCE/APPLICATION

Third generation DSCT offers substantially increased tube power at low tube potential, which may enable performing coronary CT angiography at 70-80kV in obese patients and can reduce radiation dose by 49-68%.

Next Generation Coronary CT Angiography: In vitro Evaluation of 27 Coronary Stents


PURPOSE

To evaluate in-stent lumen visibility of 27 modern and commonly used coronary stents (16 individual stent types, two stents at six different sizes each) utilizing a third-generation dual-source CT scanner.

METHOD AND MATERIALS

All stents were implanted in a plastic tube filled with contrast medium diluted to a density of 350 HU. The tube was placed in a plastic box filled with an emulsion of sunflower oil and contrast adjusted to a density of -70 HU to simulate the attenuation of epicardial fat. Scans were performed in an orientation parallel to the scanner’s z-axis for all stents (i.e. 0°) and additionally in an orientation of 90° for stents expanded to a diameter of 3.0 mm. Two stents were evaluated in all available diameters (2.25 mm to 4.0 mm) to determine the influence of stent diameter on stent lumen visibility. Scans were acquired in a retrospectively ECG-gated cardiac spiral dual-source mode with a collimation of 96x0.6 mm, tube voltage of 120 kVp with 340 mAs tube current. Evaluation was performed using a medium-soft (Bv40), a medium-sharp (Bv49) and a sharp (Bv59) convolution kernel optimized for vascular imaging. Axial reformations of all stents were used for evaluation using a window width of 1500 HU and a center of 300 HU.

RESULTS

Mean visible stent lumen of stents with 3.0 mm diameter ranged from 53.3% (IQR 48.9 - 56.7%) to 73.9% (66.7 - 76.7%) depending on the kernel applied at 0°, and was highest at an orientation of 90° with 80.0% (75.6 - 82.8%) using the Bv59 kernel, strength 4. Differences between all kernels were significant with p

CONCLUSION

Use of third generation dual-source CT scanners enables stent lumen visibility of up to 80% in metal stents and 100% in biodegradable stents in this in vitro setting. It may therefore be a valid method for detecting in-stent restenosis.

CLINICAL RELEVANCE/APPLICATION

Improved in-vitro stent lumen visibility of third generation dual-source CT scanners may allow a sufficient non-invasive method to detect or exclude in-stent restenosis in vivo.

Mesenchymal Stem Cells Improve Cardiac Function after Myocardial Infarction in Rats without Long-term Survival: A Serial 7.0T MRI Study

Xiuyu Chen (Presenter): Nothing to Disclose, Shihua Zhao: Nothing to Disclose

PURPOSE

Our aim was to in vivo monitoring the magnetically labeled mesenchymal stem cells (MSCs) after transplantation into infarcted rat hearts and determining the effect on cardiac function using a 7.0 T magnetic resonance imaging (MRI) scanner.

METHOD AND MATERIALS

Rat MSCs (male) were dual-labeled with fluorescent micron-sized particles of iron oxide (MPIO) and DM-DiI. Seven days after MI, rats (females) were randomized to injections of labeled MSCs (2x106 cells/50μL) or saline (50μL) into the border zone of infarcted myocardium. MRI was used to evaluate stem cell migration, signal intensity changes and cardiac function at baseline (1 day before transplantation), 3 days, 2 weeks and 4 weeks after transplantation, respectively. At each time point after transplantation, myocardial tissue from 5~8 hearts was analyzed by postmortem analyses.

RESULTS

MSCs could be efficiently and safely labeled with MPIO, and multipotentiality was not affected. MR hypointensities caused by the MPIOs were detected on T2*-weighted imaging at all times after MSCs transplantation. As time progressed, the signal gradually weakened and the area shrank. By real-time
polymerase chain reaction with Y-chromosome specific primers, the number of grafted MSCs in the heart decreased rapidly from 11.5% (3 days) to ~0.1% (4 weeks). At 4 weeks, double staining for iron and CD68 (resident macrophage marker) showed that most of the iron-positive cells were cardiac macrophages. This was further confirmed by transmission electron microscopy. At baseline, cardiac function measured by cine-MRI was similar between groups. By 4 weeks, ejection fractions in control hearts had significantly decreased, but this was not evident in MSC-treated hearts. In addition, MSC-treated rat hearts had significantly increased capillary density in the peri-infarct region, and lower cardiomyocytes apoptosis and collagen deposition.

**CONCLUSION**

The survival of transplanted MPIO-labeled MSCs is poor at 4 weeks after transplantation, and the MR hypointensities mainly arise from cardiac macrophage that engulfed the MPIO particles. However, MSCs attenuate left ventricular dilatation and dysfunction after MI, which may attribute to enhanced angiogenesis, inhibition of host cell apoptosis and fibrosis.

**CLINICAL RELEVANCE/APPLICATION**

our results indicate that iron oxide are not reliable marker for tracking the transplanted stem cells.

**SSJ04-05**

**Prognostic Value of Stress Dynamic CT Myocardial Perfusion Imaging in a Multi-Center Population at Intermediate to High Cardiovascular Risk**

Felix G. Meinel MD (Presenter): Nothing to Disclose, Francesca Pugliese MD, PhD : Nothing to Disclose, U. Joseph Schoepf MD : Research Grant, Bracco Group Research Grant, Bayer AG Research Grant, General Electric Company Research Grant, Siemens AG, Ulrich Ebersberger MD : Nothing to Disclose, Carlo Nicola de Cecco MD : Nothing to Disclose, Fabian Bamberg MD, MPH : Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG Research Grant, Bayer AG Research Grant, Siemens AG, Yining Wang MD : Nothing to Disclose, Yeon Hyeon Choe MD, PhD : Nothing to Disclose, Gladys G. Lo MD : Nothing to Disclose

**PURPOSE**

To determine the prognostic value of stress dynamic CT myocardial perfusion imaging (CTMPI) for future major adverse cardiac events (MACE) in a multicenter population at intermediate to high cardiovascular risk.

**METHOD AND MATERIALS**

We analyzed data of 144 patients from 6 centers in Asia, Europe and North America who had undergone coronary CT angiography (CCTA) and CTMPI. All image acquisitions were performed on a second-generation dual-source CT system. Contrast enhanced CCTA studies were acquired at rest. In addition, CTMPI imaging was performed under vasodilator stress. CCTA data were evaluated for the presence of coronary artery stenosis (>50% luminal narrowing) on a per-vessel basis. CTMPI data were visually evaluated for perfusion defects in each vessel territory. Patient follow-up was obtained at 6, 12 and 18 months after the CT examination. The prognostic value of CT findings was assessed using Kaplan-Meier statistics and multivariate Cox proportional hazards regression.

**RESULTS**

During the follow-up, 40 MACE occurred (including nonfatal myocardial infarction, n=1, unstable angina, n=13, PCI, n=23, and CABG, n=3). Patients with a perfusion defect in at least one vascular territory on CTMPI were at significantly increased risk for MACE (HR 2.50, 95% confidence interval 1.34-4.65, p=0.0040). This association remained significant after adjusting for age, gender and clinical risk factors (HR 2.41, 1.28-4.51, p=0.0064) and after further adjusting for CCTA findings (HR 2.03, 1.04-3.97, p=0.0390). The number of territories with perfusion defects was strongly predictive of MACE with adjusted HRs of 1.41, 3.44 and 4.76 for 1, 2 and 3 affected territories.

**CONCLUSION**

Myocardial perfusion abnormalities detected by CTMPI are predictive for subsequent MACE. CTMPI provides incremental predictive value for future MACE over clinical risk factors and assessment of coronary artery stenosis at CCTA.

**CLINICAL RELEVANCE/APPLICATION**

CT myocardial perfusion imaging provides incremental predictive value for future adverse cardiac events over clinical risk factors and assessment of coronary artery stenosis at CCTA.

**SSJ04-06**

**Longitudinal Changes in Hepatic Steatosis and Coronary Artery Calcification in the Elderly: A Prospective Population-based Cohort Study**

Kathleen Elizabeth Jacobs MD (Presenter): Nothing to Disclose, Sharon Sudarshan Brouha MD, MPH : Nothing to Disclose, Richele Bettencourt : Nothing to Disclose, Elizabeth Barrett-Connor : Nothing to Disclose, David Sean Ansdell MD : Nothing to Disclose, Rohit Loomba MD, MSc : Nothing to Disclose

**PURPOSE**

To investigate the relationship between hepatic steatosis and progression of coronary artery calcium (CAC) as measured by computed tomography (CT) in the elderly.

**METHOD AND MATERIALS**

We conducted a prospective study of 107 participants (62 women, 45 men; mean age 67.2) with no prior
history of heart disease. CT measurements of Agatston CAC scores, liver attenuation, spleen attenuation, volume of visceral adipose tissue (VAT), and volume of subcutaneous adipose tissue (SAT) were obtained at baseline and five-year follow up. Hepatic steatosis was defined as liver attenuation:spleen attenuation (L:S) ratio <1.1.

RESULTS
From baseline to five-year follow up, mean CAC score increased from 347.0 to 465.6 (t-test p<0.0001). VAT:SAT ratio also increased (p=0.01) despite stable BMI and correlated strongly with CAC score (r=0.41, p<0.0001). In contrast, L:S ratio increased from 1.19 to 1.33 (p<0.0001) with the proportion of patients with hepatic steatosis decreasing from 34% to 15% (p=0.001). No significant correlation was observed between change in L:S ratio and change in CAC score over the five-year time period.

CONCLUSION
Hepatic steatosis as defined by CT L:S ratio was not associated with CAC progression in our elderly study population. Although hepatic steatosis is thought to be a manifestation of metabolic syndrome, a well-known cardiovascular risk factor, our findings suggest age-related changes in liver adiposity independent of visceral adiposity and coronary artery disease.

CLINICAL RELEVANCE/APPLICATION
The association between hepatic steatosis and coronary artery disease is not well known. This is the first prospective study to demonstrate decreased hepatic steatosis despite CAC progression in the elderly.
CONCLUSION

Significant pulmonary hemorrhage is more likely in females, with coaxial technique, older age, and smaller and subsolid lesions, and less likely with subpleural lesions. Patients with suspected pulmonary hypertension may not be at increased risk for pulmonary hemorrhage after TTNLB.

CLINICAL RELEVANCE/APPLICATION

Pulmonary hemorrhage is common after TTNLB, but rarely requires intervention. TTNLB can be performed safely in patients with suspected pulmonary hypertension.

Preliminary Clinical Experience with a Dedicated Interventional Robotic System for CT-guided Biopsies of Lung Lesions: A Comparison with the Conventional Manual Technique

Michele Anzidei MD (Presenter): Nothing to Disclose, Renato Argiro: Nothing to Disclose, Andrea Porfiri MD: Nothing to Disclose, Fabrizio Boni: Nothing to Disclose, Mario Bezzi MD: Nothing to Disclose, Carlo Catalano MD: Nothing to Disclose

PURPOSE

To evaluate the clinical performance of a robotic system for CT-guided biopsy of lung lesions in comparison to the conventional manual technique.

METHOD AND MATERIALS

100 patients (63 males, 37 females, age range 48-88 years, mean age 65 +/-4 years) referred for CT-guided lung biopsy of previously diagnosed lung lesions were randomly assigned to group A (robot-assisted procedure with the ROBIO™ EX system, Perfint Healthcare - India) or group B (conventional procedure). Biopsies were performed by two operators with 2 and 8 years of experience. The size, distance from entry point and position in lung of target lesions were evaluated to assess potential homogeneity differences between the two groups. Procedure duration, dose length product (DLP), precision of needle positioning, diagnostic performance of the biopsy, rate of complications and operator preference were evaluated for significant differences between the two groups to assess the clinical performance of the robotic system as compared to the conventional technique.

RESULTS

All biopsies were successfully performed. The size (p=0.41), distance from entry point (p=0.86) and position in lung (p=0.32) of target lesions were similar in both groups (p=0.05). Procedure duration and radiation dose were significantly reduced in group A as compared to group B (p=0.001). Precision of needle positioning, diagnostic performance of the biopsy and rate of complications were similar in both groups (p=0.05).

CONCLUSION

Robot-assisted CT-guided lung biopsy can be performed safely and with high diagnostic accuracy, reducing procedure duration and radiation dose in comparison to the conventional manual technique.

CLINICAL RELEVANCE/APPLICATION

CLINICAL RELEVANCE: The precision in lesions targeting, the diagnostic performance of the biopsy sampling and the rate of complications in the robot-assisted procedures were superimposable to those of conventional biopsies. The use of the robot significantly reduced procedure duration and radiation dose in comparison to the unassisted technique. APPLICATION: Operators with different levels of experience may benefit from robot assistance in daily clinical routine, but the use of interventional robotic systems will be probably even more beneficial in clinical settings in which less expert, non-interventional operators perform simple imaging-guided procedures.

CT-guided Localization of Small Pulmonary Nodules Using Microcoils prior to Video-assisted Thoracoscopic Surgical Resection

Tianhao Su (Presenter): Nothing to Disclose, Long Jin: Nothing to Disclose

PURPOSE

To describe and optimize small peripheral pulmonary nodule localization method prior to video-assisted surgical (VATS) resection.

METHOD AND MATERIALS

This study enrolled 92 patients with 101 pulmonary nodules. Microcoils were placed next to the nodules using two random methods (with or without leaving microcoil end on the surface of pleura) under computed tomography guidance. The complications and efficacy of the implantation were evaluated. VATS resection of lung tissue containing pulmonary lesion and microcoil were performed by the direction of the microcoil marker. Histopathologic analyses of the pulmonary lesions were documented.

RESULTS
CT-guided microcoil implantation were successful in 99 (99/101, 98.0%) nodules within 1cm from the nodules but without disrupting them, while 2 (2/101, 2%) microcoils were found to be dislodged during operation. There were no difference between entire implantation (58/99, 58.6%) and leaving-microcoil-end implantation (41/99, 41.4%) method for the complications and efficacy. All nodules were removed by VATS successfully. Asymptomatic pneumothorax occurred in 16 patients, and mild pulmonary hemorrhage occurred in 9 patients, none of these patients needed further surgical treatment. The histopathologic results of the pulmonary lesions included adenocarcinomas (n =77), neuroendocrine carcinoma (n =1), metastatic carcinoma (n =1), atypical hyperplasia (n =11), hamartoma (n =1), granuloma (n =1), reactive lymph node (n =5), fibrotic hyperplasia (n =2), carbon power deposit (n =2).

CONCLUSION
Preoperative localization of small pulmonary nodules using percutaneous CT-guided microcoils implantation was useful and safe in successful VATS resection of pulmonary lesion.

CLINICAL RELEVANCE/APPLICATION
A refined localization method of pulmonary nodule using microcoil is a minimal and safe interventional approach, and is recommended prior to VATS in order to make definitive resection easy and possible.

SSJ05-04
Value of CT-guided Core-needle Biopsy in Diagnosis of Nonresolving Air Space Consolidation
Zhiwei Wang MD (Presenter): Nothing to Disclose, Xiaoguang Li MD: Nothing to Disclose

PURPOSE
To evaluate the value of CT-guided core-needle biopsy in diagnosis for patients with nonresolving pulmonary air space consolidations

METHOD AND MATERIALS
From March 2008 and June 2013, 69 patients (42 men, 27 woman; age range, 17 to 77 years; mean age, 46.2±16.4 years) presenting with nonresolving pneumonia persisting more than 2 months (mean, 4.7 months; range, 2 to 16 months) underwent CT-guided core needle biopsy using an automated core needle (18-gauge). 42 patients had undergone fiberscopic examinations with negative results before CT-guided biopsy. Histologic and bacteriologic evaluations were obtained from CT-guided biopsy. The diagnostic performance of CT-guided biopsy was assessed through comparison of surgical pathology or clinical follow-up. CT-guided biopsy complications were recorded.

RESULTS
Specimens adequate for histopathologic evaluations were obtained in 67 (97.1%) cases. Specific diagnoses were established in 60 (89.6%) patients, while 7 (10.4%) were nonspecific. The specific diagnoses were adenocarcinoma (n=13), lymphoma (n=13), organizing pneumonia (n=11), infectious pneumonia (tuberculosis, n=13; aspergillus, n=6; cryptococcosis, n=2 ), and lipid pneumonia (n=2). A mixture of chronic inflammation and fibrosis (n=6) was the most common nonspecific diagnosis. No malignancy was diagnosed on a subsequent biopsy in that cases showed non-specific chronic inflammation and fibrosis. Immediate pneumothorax was present in 6 patients of cases, but only 1 patients required pleural drainage.

CONCLUSION
Among patients with nonresolving pulmonary air space consolidation, CT-guided core needle biopsy is safe and shows high degree of diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION
CT-guided core needle biopsy is an appropriate diagnostic method for patients with nonresolving pulmonary air space consolidation.

SSJ05-05
C-arm Cone-Beam CT Virtual Navigation Guided Percutaneous Transthoracic Localization of Small Pulmonary Nodule
Taeho Kim MD (Presenter): Nothing to Disclose, Chang Min Park MD, PhD: Nothing to Disclose, Sang Min Lee: Nothing to Disclose, Hyun-Ju Lee MD, PhD: Nothing to Disclose, Jin Mo Goo MD, PhD: Research Grant, Guerbet SA

PURPOSE
To describe out initial experience with cone-beam CT virtual navigation guided percutaneous Lipiodol localization of small pulmonary nodules in 31 consecutive cases.

METHOD AND MATERIALS
From February 2013 to August 2013, 29 consecutive patients (15 male, 14 female; mean age, 61 years) with 31 small pulmonary nodules (mean size, 14.14mm; range, 4.8-35mm) underwent preoperative Lipiodol localization under CBCT virtual-navigation guidance system and included our study population. Lipiodol (mean amount, 0.19 mL; range, 0.15-0.2 mL) was injected around the pulmonary nodules through 21-gauge needle.
Procedure details—including radiation dose, diagnostic accuracy and complication rates of CBCT virtual-navigation-guided percutaneous Lipiodol localization were described.

RESULTS
All nodules were localized within 12 mm (mean distance, 2.26 mm; range, 0-12mm) from the lipiodol marking (mean diameter, 10.83 mm; range, 6-19 mm). The CT findings of pulmonary nodules were 16 pure ground glass nodules, 13 part solid nodules, and 2 solid nodules. The mean number of CT acquisitions, total procedure time, and estimated radiation exposure during lipiodol marking were 3.5, 15.9 minutes, and 5.72 mSv ± 2.64, respectively. Post-procedural complications occurred in 4 (12.9%) cases, all of which was pneumothorax. All lipiodol markings were easily visible on intraoperative fluoroscopy, and all the target nodules were completely resected. There were no difficulties on pathologic examination and their results of the target nodules included 19 invasive adenocarcinoma, 5 adenocarcinoma-in-situ, 4 atypical adenomatous hyperplasia, 1 metastatic chondrosarcoma and 2 benign lesions.

CONCLUSION
CBCT virtual-navigation-guided percutaneous lipiodol marking can be accurate, effective and safety pre-operative localization procedure, enabling highly accurate resection and safe diagnosis of small or faint pulmonary nodules.

CLINICAL RELEVANCE/APPLICATION
Cone-beam CT virtual navigation guided percutaneous transthoracic localization of small pulmonary nodule could accurately and effectively play an important role before the video assisted thoracic surgery.

How to Discriminate Malignancies Falsely-diagnosed as Non-specific Benign Lesions after Percutaneous Transthoracic Needle Biopsy from True Benign Lesions

Jung Im Kim MD (Presenter): Nothing to Disclose, Chang Min Park MD, PhD : Nothing to Disclose, Sang Min Lee : Nothing to Disclose, Kwang Gi Kim PhD : Nothing to Disclose, Jin Mo Goo MD, PhD :

Research Grant, Guerbet SA

PURPOSE
To identify the distinguishing features of malignancies falsely-diagnosed as non-specific benign lesions in pathologic examinations obtained from percutaneous transthoracic needle biopsy (PTNB) from true benign lesions.

METHOD AND MATERIALS
From January 2009 to December 2011, 1108 consecutive patients (633 males and 475 females; mean age, 62.4 years) with 1116 lung lesions (mean size, 2.7 cm ± 1.7) underwent C-Arm Cone-Beam CT (CBCT)-guided PTNB using an 18-gauge coaxial cutting needle. Among them, 285 lesions (mean size, 2.4 cm ± 1.4) in 283 patients (154 males and 129 females; mean age, 59.2 years) were diagnosed as non-specific benign lesions at pathologic evaluation. The malignancy rate of these non-specific benign pathologies was investigated. To evaluate the discriminating clinical, radiological and pathological findings of these malignancies falsely-diagnosed as non-specific benign lesions from true benign lesions, univariate and multivariate logistic regression analyses were performed.

RESULTS
Among 285 lesions, 24 (8.4%) were finally diagnosed as malignant, 202 (70.9%) as benign and 59 (20.7%) as indeterminate. The negative predictive value (NPV) of the non-specific benign lesions was 89.4% (202/226). For 81 lesions in which the pathologic results were granulomatous inflammation and 141 lesions with negative CT reports for lung cancer, NPVs were 100% and 99.3%, respectively. Multivariate analysis revealed that positive CT reports for lung cancer (odds ratio (OR), 29.7; P<0.001) and granulomatous inflammations on PTNB (OR, 0.03; P=0.018) were significant discriminating factors of these malignancies falsely-diagnosed as benign lesions from true benignancies with excellent differentiating accuracy (area under the ROC curve, 0.944).

CONCLUSION
Among pulmonary lesions showing non-specific benign pathologies on PTNB, positive CT reports for lung cancer and pathologic results of granulomatous inflammations on PTNB were significant discriminating factors for malignancies falsely-diagnosed as non-specific benign lesions.

CLINICAL RELEVANCE/APPLICATION
Among non-specific benign biopsies, false negative and true negative lesions can be accurately discriminated through evaluation of diagnostic CT and pathologic reports of PTNB.
Dual-source CT of Chest in Blunt Thoracic Trauma: Reduced Aortic Motion Using a Novel Iterative Temporal Resolution Optimization Algorithm

Teresa I-Han Liang MD (Presenter): Nothing to Disclose, Patrick McLaughlin FFR(RCSI): Nothing to Disclose, Shamir Rai BSc: Nothing to Disclose, Darra Thomas Murphy MD, FRCP: Nothing to Disclose, Luck Jan-Luck Louis MD: Nothing to Disclose, Tim O’Connell MD, Meng: President, Resolve Radiologic Ltd, Ana-Maria Bilawich MD: Nothing to Disclose, John R. Mayo MD: Speaker, Siemens AG, Savvas Nicolaou MD: Nothing to Disclose

PURPOSE

Motion artifacts commonly reduce diagnostic confidence in patients with suspected blunt aortic injury. In this study we evaluate a novel iterative temporal resolution optimization (TRO) algorithm in patients with blunt chest trauma undergoing contrast enhanced ultra high pitch dual source CT.

METHOD AND MATERIALS

Twenty-two patients who presented to a level one trauma centre between February 18 to March 25, 2014 with blunt thoracic trauma were included. All patients were scanned using a standardized ultra high pitch dual source CT protocol (UHP) using a single CT system. Aortic Motion artifact was scored using a five-point Likert scale modified from CCTA literature at multiple locations of the heart and aorta by two readers (Score of 1 = absence of motion artifacts or noise-related blurring in any vessels; score of 5 = severe or circumferential motion artifact, prominent mural discontinuity). Mean and standard deviation of CT values within aorta, muscle and air were recorded and signal to noise (SNR) and contrast to noise (CNR) ratios were generated as a quantitative index of image quality. Student t-test and Wilcoxon rank sum test were used for statistical analysis and p<0.05 was considered significant.

RESULTS

Aortic motion scores were significantly lower on UHP-TRO as compared with UHP images for both readers (Aortic valve 3.5±3 vs 5±2; Aortic sinus 1±1 vs 4±3; Sinotubular junction 1±1 vs 4±2; Ascending aorta 1±1 vs 3±2; p<0.0001). Motion scores were not significantly different at the aortic arch, isthmus and descending aorta on UHP-TRO as compared with UHP images (Arch 1±0 vs 1±0.75; Isthmus 1±0 vs 1±0.75; Descending aorta 1±0 vs 1±0.75). Mean SNR was 19.5% higher on UHP as compared with UHP-TRO (26.42 vs 21.27, p=0.01) and mean CNR scores were 27.7% higher on UHP images (13.4 vs 9.65, p=0.002).

CONCLUSION

Temporal Resolution optimized reconstruction of ultra high pitch dual-Source CT of the chest significantly improves motion artifact of the aorta in blunt thoracic trauma at the sacrifice of a mild reduction in SNR and CNR.

CLINICAL RELEVANCE/APPLICATION

Iterative temporal resolution optimized reconstruction of ultra high pitch Dual-Source CT images of the chest qualitatively improves motion artifact in blunt thoracic trauma patients facilitating more accurate assessment of the aorta.

Motion Artifact Reduction from High-pitch Dual-source CT Pulmonary Angiography

Paul Michael Bunch MD (Presenter): Nothing to Disclose, Urvi Pravin Fulwadhva MD: Nothing to Disclose, Jeremy Robert Wortman MD: Nothing to Disclose, Andrew Primak PhD: Employee, Siemens AG, Aaron D. Sodickson MD, PhD: Research Grant, Siemens AG

PURPOSE

To compare quantitative measures of cardiac pulsation and respiratory motion artifact in CT pulmonary angiograms (CTPA) performed using a high-pitch dual-source protocol and a single-source protocol.

METHOD AND MATERIALS

In this retrospective, IRB-approved, HIPAA-compliant study, 50 CTPA exams were included using each of two protocols: 1) a high pitch dual-source (DS) protocol and 2) a routine single-source (SS) protocol. Neither protocol used ECG gating. Inclusion criteria were patient age >18 years, both arms elevated above the scan region, and no prior lobectomy or pneumonectomy. All scans were performed in the Emergency Department on a Siemens Definition Flash scanner. Each scan was evaluated for motion artifact producing a “double image” appearance, and when present, the greatest anatomic overlap interval was measured perpendicular to the axis of the ascending aorta, left ventricular lateral wall, and diaphragm. Measurements were performed on axial images for aortic and cardiac motion and on coronal reformatted images for diaphragmatic motion. Statistical analysis was performed using one way ANOVA.
RESULTS

There was no statistically significant difference in patient gender, age, or effective diameter between the two cohorts. High-pitch DS CTPA scans used a mean pitch of 2.9 (range 1.6-3.0), resulting in a mean scan duration of 0.8 seconds (range 0.6-1.7). Routine SS technique used pitch 0.75 for a mean scan duration of 4.6 seconds (range 3.6-5.8). DS outperformed SS technique with respect to quantitative measures of ascending aortic, cardiac, and diaphragmatic motion. Mean distances between motion-artifact double images were reduced at the ascending aorta from 4.1 mm with SS to 0.3 mm with DS, at the left ventricular lateral wall from 5.3 mm with SS to 1.2 mm with DS, and at the diaphragm from 2.2 mm with SS to 0.1 mm with DS, all with p<0.001.

CONCLUSION

High-pitch dual-source CTPA is an effective means to significantly reduce artifacts resulting from ascending aortic, cardiac, and diaphragmatic motion.

CLINICAL RELEVANCE/APPLICATION

High-pitch dual-source CTPA significantly reduces cardiac and respiratory motion artifact without the need for ECG synchronization, which may result in increased diagnostic confidence during evaluation for pulmonary embolus as well as cardiac and aortic causes of chest pain.
protocol. Group C consisted of 58 patients who underwent thoracic aortic CTA using a bolus triggering (tracking) technique. The primary endpoint was comparing the duration (in seconds) between the acquisition time of the last scout image and the first axial post-contrast image in all three groups. The secondary endpoint was vascular enhancement (HU) of the main pulmonary artery (MPA) and thoracic aorta. Statistical techniques included a 3-way ANOVA for three group analysis and t-tests to compare specific protocols. p < 0.05 was considered statistically significant.

RESULTS

There was a statistically significant (p<0.0001) difference in the average delay between the last scout image and axial acquisition in the three groups: group A (timing) 330 seconds (CI 302-358), group B (triggering) 250 seconds (CI 221-279), and group C (fixed delay) 160 seconds (CI 136-184); group A vs B (p=0.002), B vs C (p<0.0001), and A vs C (p<0.0001). Comparing MPA enhancement between group A (416HU, CI 388-444) and group C (442HU, CI 411-473) yielded no statistically significant difference (p=0.207). Comparing aortic enhancement between group B (363HU, CI 338-389) and group C (425HU, CI 399-451) yielded a significant difference (p=0.001), with greater enhancement in group C. Similar volumes of contrast were used in the three groups.

CONCLUSION

CTA using a fixed delay contrast enhancement technique is almost 3 minutes faster to perform than a timing bolus, with no impairment in vascular enhancement. This appears to be due to time taken by the technologists to perform the necessary steps. Three minutes is about 10% of the average CT scan slot duration.

CLINICAL RELEVANCE/APPLICATION

Choosing a bolus triggering or a fixed delay could shorten the scan duration for urgent ED CTAs and allow for more patients, and potentially less stable patients, to get scanned.

SSJ06-05

Exponentially Decelerated Contrast Media Injection Rate Combined with A Novel Patient-specific Contrast Formula Reduces Contrast Volume Administration During Computed Tomography Pulmonary Angiography

Charbel Saade MS (Presenter): Nothing to Disclose, Hussain Al-Mohiy: Nothing to Disclose, Mukbil H. Hourani MD: Nothing to Disclose

PURPOSE

To investigate opacification of the pulmonary vasculature during CTPA using a patient-specific contrast formula and exponentially decelerated contrast media injection rate.

METHOD AND MATERIALS

CTPA was performed on 150 patients with suspected PE using a 256 channel computed tomography scanner and a dual barrel contrast injector. Patients were randomly assigned to two equal protocol groups: protocol A, the department’s conventional protocol, employed a patient-specific contrast formula based on measured patient cardiovascular dynamics. Protocol B involved the use of a patient-specific contrast formula combined with exponentially decelerated contrast media injection rate. Both protocols used a 50 mL saline flush at 4.5 mL/s and a craniocaudal scan direction. Patient age and gender were equally distributed across both groups. The mean cross-sectional opacification profile of eight central and eleven peripheral pulmonary arteries and veins were measured for each patient and arteriovenous contrast ratio (AVCR) calculated for each lung segment. Protocols were compared using Mann-Whitney U non-parametric statistics. Jackknife alternative free-response receiver operating characteristic (JAFROC) analyses were used to assess diagnostic efficacy. Inter-observer variations were investigated using Kappa methods.

RESULTS

A number of pulmonary arteries demonstrated increases in opacification (p<0.02) for protocol B compared with A whilst opacification in the heart and all veins was reduced in protocol B (p<0.03). Subsequently, increased AVCR in protocol B compared with A was observed at all anatomic locations (p<0.0002) where this ratio could be calculated. An increase in JAFROC figure of merit (p<0.0002) and inter-observer variation was observed with protocol B compared with A with the latter metric increasing from (κ = 0.3) to (κ = 0.73) respectively. Mean contrast volume was reduced in protocol B (29±4 mL) compared to A (33±5 mL).

CONCLUSION

Significant improvements in visualisation of the pulmonary vasculature can be achieved with a low contrast volume CT acquisition using an exponentially decelerated contrast media injection rate and a patient-specific contrast formula.

CLINICAL RELEVANCE/APPLICATION

Matching contrast injection timing with vessel dynamics significantly improves vessel opacification and reduces contrast dose in the assessment of pulmonary embolism during computed tomography pulmonary angiography.

SSJ06-06


Alexi Otrakji MD (Presenter): Nothing to Disclose, Efren Jesus Flores MD: Nothing to Disclose, Roberto Lo Gullo MD: Nothing to Disclose, Jo-Anne O. Shepard MD: Consultant, Agfa-Gevaert Group
PURPOSE
To assess if "contrast enhanced routine chest dual energy CT protocol" (DECT-RC) can provide acceptable vascular enhancement and additional parenchymal information compared to "single energy CT pulmonary angiography" protocol (SECT-PA).

METHOD AND MATERIALS
Our IRB approved retrospective study included 200 adult patients who underwent either DECT-RC (n= 100 patients, M: F 47:53, mean age 62±15 years, mean weight 76±19 kg) or SECT-PA (n=100 patients, M: F 43:57, mean age 59±17 years, mean weight 84±24 kg). All CT examinations were performed on dual source MDCT (Siemens Definition Flash) or single source 64-row MDCT (GE 750 HD Discovery). For DECT-RC, we generated images at 60 keV, pulmonary blood volume images (PBV) and virtual non-contrast images (VNC) images in transverse plane at 2.5mm thickness. Transverse SECT-PA images were reconstructed at both 1.25 and 2.5mm thicknesses. Two thoracic radiologists assessed main, lobar, segmental and subsegmental pulmonary arterial enhancement and filling defects in addition to diagnostic confidence, pulmonary and mediastinal abnormalities on 60 keV, PBV and VNC images. CTDI vol, and DLP were recorded for each patient.

RESULTS
Radiation dose for DECT-RC (7.2 ± 2.1 mGy, 260.4 ± 83.2 mGy.cm, 3.6 ± 1.2 mSv) was significantly lower than SECT-PA protocol (15 ± 7.9 mGy, 499.3 ± 276.4 mGy.cm, 7 ± 3.9 mSv) (p=0.0040). Optimal to excellent enhancement in pulmonary arteries was noted with DECT-PA (85%, 85/100 patients) and in 82% of SECT-PA (82/100 patients) (p>0.05). Limited to unacceptable pulmonary arterial enhancement was noted in % (15/100 patients) with DECT-RC and % (18/100 patients) with SECT-PA protocols. PBV images were deemed to provide helpful incremental value in making the diagnosis in 72% of patients (72/100) mostly in patients with perfusion defects from air trapping (better seen on PBV), consolidation, atelectasis, and pulmonary embolism. The incremental value of VNC images were helpful in 4/100 patients only with high attenuation lung nodules (n=1) and mediastinal lymph nodes (n=3).

CONCLUSION
Contrast enhanced routine chest protocol with DECT has the potential to replace SECT pulmonary angiography protocol for providing required pulmonary arterial enhancement as well as helpful additional information for evaluation of lung lesions.

CLINICAL RELEVANCE/APPLICATION
Routine chest CT with DECT can provide similar or better information compared to single energy CT pulmonary angiography without incurring any radiation penalty.
medical records for patients with pathologically confirmed biphenotypic tumors. Clinical data and serum tumor markers were recorded. Two reader consensus of imaging features obtained for computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET) and ultrasound.

RESULTS
Chronic liver disease (CLD) was present in 36% of subjects; cirrhosis in 28%. Serum AFP was elevated in 29/42 (69%), CA 19.9 in 21/35 (60%) and both AFP and CA 19.9 were elevated in 16/34 (47%). On MRI, tumors were T2 hyperintense in 18/19 (95%) and T1 hypointense in 19/19 (100%). Only 1/27 (4%) exhibited classic HCC feature of arterial hyperenhancement followed by washout. On CT and MRI, nearly three quarters (20/27, 74%) had peripheral hyperenhancement followed by peripheral washout or fade coupled with gradual central enhancement. Other patterns included persistent peripheral enhancement on all phases (n = 3), separate foci of arterial and delayed enhancement (n = 2), and hypoenhancement (n = 1). Pseudocapsule was present in 6; biliary obstruction in 3 and liver capsule retraction in 8. Peripheral hypoechoogenicity and central hyperechogenicity was the most common ultrasound feature, 5/12 (43%). PET demonstrated hypermetabolism in 9/11 (82%).

CONCLUSION
Biphenotypic tumors do not show strong association with CLD and serum tumor markers are inconsistently elevated. They exhibit variable imaging characteristics on CT and MRI, but classic features of HCC are usually not seen. Most have enhancement patterns which may suggest alternative diagnoses such as biphenotypic tumor, CCA or metastasis. Two distinct tumor components are rarely seen. Discordance between imaging findings and laboratory tumor markers should raise suspicion of biphenotypic tumor. Mixed tumors tend to be very metabolically active at FDG PET. Ultrasound is not specific.

CLINICAL RELEVANCE/APPLICATION
Suggesting an etiology other than HCC may be an important role of imaging in these patients given the significant differences in management of HCC compared with biphenotypic tumors, CCA or metastases.

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Evaluation of a New Manganese-based Orally-Administered Hepatobiliary MR Contrast Agent


PURPOSE
To determine the qualitative and quantitative efficacy of orally-administered manganese chloride tetrahydrate (CMC-001) for the evaluation of focal liver lesions (FLL) by MRI.

METHOD AND MATERIALS
Unenhanced alone and combined unenhanced and CMC-001 enhanced T1- and T2-weighted images at 1.5T of 30 healthy volunteers and 134 patients included in five Phase I and II trials or for compassionate use were evaluated separately by one independent reader who was blinded to patient information, contrast agent dose and clinical diagnosis. Region-of-interest signal intensity (SI) measurements were acquired from the non-tumorous liver parenchyma, common bile duct (CBD), portal vein (PV), paraspinal muscle and FLL, when present. FLL were also scored for visualization, delineation, detection confidence and characterization. Mean signal intensity measurements and lesion contrast-to-noise ratios (CNR) were compared between pre- and post-contrast images. The detection of benign and malignant-appearing lesions were compared between unenhanced alone and combined unenhanced and CMC-001 enhanced images.

RESULTS
178 unenhanced and CMC-001 enhanced image pairs were available for evaluation (some patients were imaged more than once). Comparing T1-weighted unenhanced to enhanced images, there was a significant increase in the SI of both liver parenchyma and CBD (37% and 412%, respectively; p<.0004). There was also a statistically significant improvement in the lesion-to-liver CNR after CMC-001 administration (median: pre: 4.22, post: 12.12; p<.0001). Compared to unenhanced images alone, the combination of unenhanced and CMC-001enhanced images demonstrated 13% more malignant-appearing lesions. Also for malignant-appearing lesions, confidence in lesion localization in the ‘high’ category increased from 41% to 56% (p<.0001), while confidence in lesion visualization and delineation in the ‘excellent’ category increased from 32% to 44% (p<.0001) and from 18% to 36% (p<.0001), respectively.

CONCLUSION
This initial analysis shows that orally-administered manganese chloride tetrahydrate provides qualitative and quantitative improvement over unenhanced MRI for visualization and detection of focal liver lesions.

CLINICAL RELEVANCE/APPLICATION
Manganese chloride tetrahydrate could be an alternative contrast agent for patients with known or suspected focal liver lesions in whom gadolinium-based contrast agents are contraindicated, particularly in patients with renal insufficiency.
Diagnostic Management of Benign Hepatocellular Lesions Imaged at MR - Hepatobiliary Phase versus CEUS

Lambros Charles Tselikas MD (Presenter): Nothing to Disclose, Frederic Pigneur MD: Nothing to Disclose, Marion Roux: Nothing to Disclose, Vincent Roche: Nothing to Disclose, Laurence Baranes MD: Nothing to Disclose, Julien Calderaro: Nothing to Disclose, Charlotte Costentin: Nothing to Disclose, Damien Medico: Nothing to Disclose, Marjan Djabbari: Nothing to Disclose, Alexis Laurent: Nothing to Disclose, Alain Rahmouni MD: Nothing to Disclose, Alain Luciani MD, PhD: Nothing to Disclose

PURPOSE
To compare the added value of contrast-enhanced ultrasound (CEUS) and delayed hepatobiliary phase (HBP) imaging using Gd-BOPTA enhanced MRI in patients with atypical benign hepatocellular lesions (BLT).

METHOD AND MATERIALS
Sixty four BLT - 37 focal nodular hyperplasia (FNH) and 27 hepatocellular adenomas (HCA) - with atypical presentation on liver MR using extracellular Gd chelates (EC-MRI) in 41 patients where retrospectively included in this IRB approved study. All patients underwent HBP MRI and CEUS. Two radiologists independently reviewed 2 sets of images: set 1 EC-MRI and HBP MRI; set 2 EC-MRI and CEUS. All HCA and 38% of all FNH were documented on pathology, the remaining FNH being diagnosed in board decisions and a median 18 months follow-up. Sensitivity (Se) specificity (Spe) were compared between the two sets, and subgroup analysis according to lesion's size were performed.

RESULTS
Regardless of lesion size, the respective Se and Spe of both data sets were not statistically different (94 and 100% vs. 78 and 92% respectively; p=0.11 and p=0.48). For lesions larger than 35mm, although both sets had similar excellent specificity (100%, p = 1) the sensitivity was higher for EC-MRI+HBP set (100% vs. 33%; p=0.04).

CONCLUSION
Although the overall performances of EC-MRI + CEUS and EC-MRI + HBP MRI are similar, the use of HBP should be advocated over CEUS in larger than 35mm large benign hepatocellular lesions.

CLINICAL RELEVANCE/APPLICATION
Size influences HBP and CEUS diagnostic performances. the use of HBP should be advocated over CEUS in larger than 35mm large benign hepatocellular lesions.

Detection of Liver Metastases Using a High Spatial Resolution Ultrasound Contrast Mode: Impact of Small Liver Metastases in Different Primary Malignancies

Hans-Peter Weskott MD (Presenter): Luminary, General Electric Company Speaker, Bracco Group, Michael Hoepfner MD : Nothing to Disclose, Carsten Bohm : Nothing to Disclose

PURPOSE
Retrospective evaluation of the number and size distribution of liver metastases of different primaries by analyzing digitally stored triphasic CEUS loops of the liver in a two center study

METHOD AND MATERIALS
201 patients with 287 CEUS examinations were included. US basic examination prior and after CEUS examination of 1.2mL Sonovue™ bolus injection (Bracco, Milan, Italy) in patients with metastatic liver disease. CEUS was performed in a pulse inversion technique (LOGIQ E9, GE Healthcare, Milwaukee, IL, USA). Patients were referred for CEUS with intention to treat, or for staging/restaging after chemotherapy or tumor resection. Representative loops of all triphasic CEUS examinations were digitally stored. Most frequent primaries: GI tract tumors (n=76, including 9 follow ups), breast cancer (n=89, 41 follow ups), melanoma (n=32, 9 follow ups). Size distribution was defined in 4 groups: Group 1: <5mm, group 2: 5.1mm -10mm, group 3: 11mm-20mm, group 4: >20mm.

RESULTS
In 287 examinations 3264 metastases were detected. Size distribution of all included patients: Group 1: 14.0%, 2: 37.9%, 3: 28.3%, 4: 18.8%. Patients with GI tract metastases (76 exams in 52 patients, 313 metastases) showed the largest metastases: Group 1: 4.0%, 2: 28.9%, 3: 31.1%, 4: 37.3%. Size distribution in breast cancer according to the four groups (n=89 exams in 41 patients, 1526 metastases): Group 1: 22.5%, 2: 45.2%, 3: 22.2%, 4: 10.3%. Size distribution in melanoma group (32 exams in 20 patients, 337 metastases): Group 1: 19.2%, 2: 38.9%, 3: 31.5%, 4: 10.6%. Using high resolution CEUS technique small metastases down to 3mm in size could be detected.

CONCLUSION
CEUS is capable to detect also small metastases below 10mm accounting for 1/3 (GI tract) to 2/3 (breast cancer) of all metastases.

CLINICAL RELEVANCE/APPLICATION
Detection of especially small metastases is most important for the management of metastatic diseases. In patients with a high likelihood of liver metastases high resolution CEUS should be included early in the diagnostic work up.
Contrast-enhanced Sonography (CEUS) Assessment of Dirty, Cystic-like Focal Liver Lesions (FLLs)

**PURPOSE**
Dirty liver cysts at US represent a challenge, since true cysts can mimic a solid FLL while solid FLLs may be confused with cysts. Our single-cancer centre study analyses the additional value of microbubbles contrast injection in cancer patients with "dirty" cysts at baseline US.

**METHOD AND MATERIALS**
In a 7-year period we identified 48 patients with 50 "dirty" cysts (hypoechogenic content in 24 lesions, lack of posterior enhancement in 10 lesions, both findings in 16 lesions) at US. These subjects were imaged for cancer staging/follow-up and had no previous study for comparison. They prospective underwent sulphur hexafluoride-based contrast medium injection. Diagnosis was confirmed by further imaging in 30 lesions, follow-up in 18, and biopsy in 2.

**RESULTS**
US was indeterminate, by definition, in all lesions (9-39 mm, mean 20). The liver echotexture was fatty in 37 patients and normal in the others. An inhomogeneous content was more predictive for solid nature than lack of dorsal enhancement did. CEUS correctly diagnosed all 24 true cysts (100%) in 24 patients and 25/26 solid lesions (96%; 18 metastases and 7 hemangiomas) in the remaining 24. One deeply located metastasis was incorrectly diagnosed as cyst by CEUS.

**CONCLUSION**
CEUS allows achieving a definitive diagnosis in patients with US findings of "dirty" liver cyst. CEUS allows ruling out a solid FLL and characterizing truly solid FLLs. This is of special value in countries where US is regarded as the first modality for liver survey.

**CLINICAL RELEVANCE/APPLICATION**
It is not uncommon that liver cysts show an atypical appearance at US. In these cases CEUS allows to solve the diagnostic pitfall avoiding further imaging with more expensive and invasive modalities.

Contrast-enhanced Hepatic Angiography: A Novel CEUS Technique to Image Intrahepatic Arteries

**PURPOSE**
To evaluate the arterial hepatic architecture including diameter, course and branching by using a pulse inversion technique in patients with either diffuse and/or focal liver disease.

**METHOD AND MATERIALS**
For detection or characterization of focal liver lesions (FLL) in normal/or diffuse liver disease 137 patients underwent CEUS. With arrival of the first bubbles (contrast agent Sonovue, Bracco Company, Milan,Italy) a sweep of the right or left liver lobe was performed using a low MI harmonic imaging technique (pulse inversion, Logiq E9, C1-5, GE Healthcare, Milwaukee, USA). Cine capture was started to visualize the vascular continuity of intrahepatic arteries. Average accumulation time for a cine capture sequence was 6.5s ±1.8s. A successful examination was defined when at least three main branches of the right or left hepatic artery were imaged. Loops were reviewed to compare course and size of intrahepatic arteries, including 44 patients with liver metastases, 28 within liver cirrhosis and 65 patients without cirrhosis and malignant FLL among them 18 patients with benign FLL.

**RESULTS**
The success rate was 88%. In cirrhotic patients 78% had a tortuous course and dilated arteries including at least three main arterial branches. The mean diameter of the right or left main tortuous artery was 3.36±0.92mm. The smallest arterial branches measured 0.4mm. Compared to patients without collateral circulation (n=24), diameters were thinner in patients with collateral circulation (n=4) (3.39±0.96mm vs. 2.58±1.15mm , p=0.138). In non-cirrhotic patients, 54% showed corkscrew arteries involving no more than two main arterial branches, mostly seen in patients under chemotherapy. In comparison the mean diameter of the non-cirrhotic liver was thinner (2.32±0.89mm, p=0.000). Curly arteries were seen more often in the elderly (r=0.285). In metastatic disease, 45.4% patients had curly arteries. Tortuous feeding arteries were seen in all FNH and HCC. Arterial stenosis was seen in a patient with lung cancer without liver metastasis.

**CONCLUSION**
CEHA is capable to image changes of the intrahepatic arterial architecture and thus contributes to characterize the vascular status in patients with diffuse or focal liver diseases.

**CLINICAL RELEVANCE/APPLICATION**
CEHA shows differences in in the arterial architecture of patients with diffuse liver disease, especially in patients under or after chemotharapy, it helps to image tumor supplying arteries in benign FLL and HCC.
SSJ08
Gastrointestinal (Small Bowel Imaging)

Scientific Papers

CT GI
AMA PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00
Tue, Dec 2 3:00 PM - 4:00 PM Location: E353C

Participants

Moderator
Dean Daniel T. Maglinte MD : Consultant, Cook Group Incorporated
Moderator
Perry J. Pickhardt MD : Co-founder, VirtuocTC, LLC Stockholder, Cellectar Biosciences, Inc

Sub-Events

SSJ08-01
CT Detection of Complicated and Uncomplicated Meckel’s Diverticulum

PURPOSE
To determine how often complicated and uncomplicated Meckel’s diverticulum is detected on CT in pediatric and adult population.

METHOD AND MATERIALS
Forty (8 pediatric and 32 adult) patients (29 males and 11 females; average age: 46.2±23.7) with pathologic diagnosis of Meckel’s diverticulum who had CT exam before surgical resection were evaluated. These included 26 asymptomatic adult patients with incidentally found Meckel’s diverticulum during unrelated abdominal surgery, and 14 (8 pediatric and 6 adult) patients with complicated Meckel’s diverticulum (4 bleeding, 6 small bowel obstruction [SBO], 2 acute diverticulitis, 1 incisional hernia, and 1 inverted Meckel’s diverticulum). A total of 85 CT exams (23 CT exams for 14 patients with complicated Meckel’s diverticulum, and 62 CT exams for 26 asymptomatic patients) obtained with multiple different scanners and techniques were evaluated for detection of Meckel’s diverticulum and its complications. Technical factors for CT including IV and positive oral contrast material and subjective CT quality (excellent, good, fair, poor), and patient’s factors including amount of peritoneal fat and ascites (none, minimum, moderate, large) were compared to detection of Meckel’s diverticulum using mixed-effect logistic regression models.

RESULTS
Meckel’s diverticulum was detected in 19 of 40 (47.5%) patients (average diameter: 17.1±7.7mm, length 42.6±14.7mm). Complicated Meckel’s diverticulum was detected in 8 of 14 (57.1%) patients (2 bleeding, 2 SBO, 2 diverticulitis, 1 hernia, and 1 inverted Meckel’s) on at least one CT exam, and 13 of 23 (56.5%) total CT exams. Uncomplicated Meckel’s diverticulum was detected in 11 of 26 (42.3%) patients on at least one CT exam, and 16 of 62 (25.8%) total CT exams. Amount of peritoneal fat (p=0.02) was related to detection of Meckel’s diverticulum. Amount of ascites (p=0.06) and subjective quality of axial CT (p=0.05) were not statistically significant, but tended to be related to its detection, whereas IV (p=0.59) or oral contrast (p=0.41) were unrelated to its detection.

CONCLUSION
Complicated Meckel’s diverticulum was detected in 56.5% of CT exams, and uncomplicated Meckel’s diverticulum was detected in 25.8% of CT exams.

CLINICAL RELEVANCE/APPLICATION
Complicated Meckel’s diverticulum should be considered in patients with abdominal/gastrointestinal symptoms, and its possible CT findings should be sought.

SSJ08-02
What is the Predictive Factors of Bowel Viability and Prognosis in Bowel Ischemia? Retrospective Review of Image Findings of Abdomen Computed Tomography (CT)
Hyun Soo Kim (Presenter): Nothing to Disclose , Sung Eun Ahn : Nothing to Disclose, Dong Ho Lee MD : Nothing to Disclose, Seong Jin Park MD, PhD : Nothing to Disclose, Joo Won Lim : Nothing to Disclose, Han Na Lee MD : Nothing to Disclose, Sung Kyoung Moon : Nothing to Disclose, Yunkyung Shin : Nothing to Disclose

PURPOSE
To evaluate the imaging predictive factors and clinical factors of bowel viability and prognosis in abdomen CT of the patients with bowel ischemia.

METHOD AND MATERIALS
This retrospective study enrolled 72 patients (M:F ratio = 35:37, mean age = 63.2 years) who underwent
abdomen CT due to bowel ischemia or infarction. Two radiologists reviewed two phase abdomen CT images without information of their recovery status in consensus. The following imaging features were assessed; involving bowel location, involving pattern (multifocal, continuous), involving length (<25cm, 25~50cm, 50~75cm, >75cm), thickness of the most thickened bowel, mucosal and mural enhancement degrees (absence, decreased, similar to the adjacent viable bowel, increased), mucosa and serosa disruption, delayed enhancement of mucosa and serosa, ancillary findings (mesentery vessel thrombosis, other organ infarction, portal vein gas, and pneumatosis). Statistical analyses were performed for the comparison between good and poor prognosis patients by using Chi-square, Fisher's exact and paired-T tests.

RESULTS
According to the clinical data, patients were divided into two groups - group 1 who underwent the bowel resection, or were expired (12), and group 2 who recovered bowel viability with conservative manage (60). In comparison between 2 groups, small bowel involvement, longer segment involvement, decreased mucosal and mural enhancement degrees, and the presence of mucosal disruption, mesenteric vessel thrombosis, and other abdominal organs infarction were statistically related to the poor clinical results (p <0.05). Of the 23 patients who showed lack or decreased mucosal enhancement of involved bowel, small bowel involvement (p<0.001) and involved length (p= 0.013) were statistically associated with the prognosis.

CONCLUSION
Significant CT findings related to the prognosis in bowel ischemia are small bowel involvement, longer segment involvement, decreased mucosal and mural enhancement, mucosal layer disruption, mesenteric vessel thrombosis, other abdominal organs infarction.

CLINICAL RELEVANCE/APPLICATION
When the ischemic bowel showed absent or decreased mucosal enhancement in abdomen CT, small bowel and long length involvement is the bed prognostic factor requiring the prompt and active treatment.

SSJ08-03
Comparison of Radiological and Clinical Differential Points of Small Bowel Obstruction between Surgically and Non-surgically Managed Groups
Seungmin Lee (Presenter): Nothing to Disclose, Wooyul Paik MD: Nothing to Disclose, Mi-Hyun Park MD: Nothing to Disclose, Keum-Nahn Jee MD, PhD: Nothing to Disclose

PURPOSE
To analyze and compare the radiological and clinical differential points between surgically and non-surgically managed groups in patients with small bowel obstruction (SBO).

METHOD AND MATERIALS
To evaluate and compare the imaging findings of contrast enhanced abdominal 3D CT between surgically and conservatively managed groups of patients with SBO in 252 cases of 227 patients (mean age of 57 year-old, male to female ratio 118 : 109) from Jan 2009 to March 2013. To analyze the CT findings of proximal bowel dilatation, obstruction site with definite transition zone, small bowel feces sign, mesenteric whorl or crowding around obstruction site, strangulation, closed loop obstruction, and combined peritoneal changes such as ascites, mesenteric haziness, seeding nodules, etc. retrospectively by consensus of two abdominal radiologists. To review their past medical history including previous operation history of abdomen or pelvis, peritoneal inflammation with or without enterocolitis and trauma. To perform statistical analyses using Chi-square test and student t-test between the two groups.

RESULTS
No significant statistical deference between the two groups about past medial history of surgery, trauma or peritonitis (P>0.05). In surgically managed groups, significantly increased incidence of small bowel feces sign (p=0.007), strangulation or closed loop obstruction (p<0.0001), and peritoneal changes such as ascites, mesenteric haziness, seeding nodules, etc. (p=0.0001) in 3D CT findings.

CONCLUSION
Contrast enhanced 3D CT findings of small bowel feces sign, strangulation or closed loop obstruction and combined peritoneal changes of ascites, nodules or haziness are statistically significantly increased in surgically managed group of patients with SBO than in non-surgically managed one.

CLINICAL RELEVANCE/APPLICATION
In the evaluation of CT findings with SBO, our results could be considered in decision making of patient's management.

SSJ08-04
Determining the Need for Surgical Intervention for Small Bowel Obstruction Based on MDCT Findings: Multi-reader Study Comparing Experienced Radiologists with Newly Board-certified Radiologists

PURPOSE
Small bowel obstruction (SBO) is an important diagnosis and Multi-detector CT (MDCT) plays a critical role in the evaluation of suspected SBO. The purpose of this study is to determine how good MDCT is in predicting the need for surgical intervention (within 72 hours), bowel resection and bowel ischemia. Additionally, to compare the differences between experienced radiologists and newly board-certified radiologists in identifying SBOs that required surgical intervention.

**METHOD AND MATERIALS**

MDCT studies performed at the time of admission for suspected SBO in 85 consecutive adults were systematically reviewed by 12 board-certified radiologists. Six of the radiologists were newly board-certified radiologists. The other six radiologists were experienced radiologists. The examinations were scored for the presence or absence of findings relevant to SBO and associated bowel ischemia. Each reader rated the likelihood: 1) of the need for surgical exploration, 2) that bowel ischemia would be found at surgery, and 3) that bowel resection would be required. A 5-point scale was utilized for each question (1=definitely not; 2=probably not, 3=possibly/unsure, 4=probably, 5=definitely).

**RESULTS**

The pooled (all 12 radiologists) ROC area-under-the-curve (AUC) for surgical need was 0.802. Pooled ROC AUC for the presence of ischemia and need for bowel resection was 0.795 and 0.783, respectively. Considering a score of 3-5 as positive, pooled sensitivity and specificity for predicting the need for surgery was 86.1% and 65.5%, respectively. AUC for surgical need between the junior and senior radiologists was the same (0.802). The AUC for bowel ischemia between the junior and senior groups was 0.734 and 0.856, respectively. The AUC for bowel resection was 0.808 (junior) and 0.758 (senior).

**CONCLUSION**

Radiologist are moderately successful in evaluating the need for patients with suspected SBO to go to surgery based on MDCT findings. There are no significant differences in the abilities of newly board-certified radiologists and experienced radiologists in identifying SBOs that require imminent surgical intervention.

**CLINICAL RELEVANCE/APPLICATION**

SBO is an important diagnosis and we have shown that radiologists using MDCT findings can be helpful in guiding clinicians to the appropriate diagnosis and treatment.

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**SSJ08-05 Dynamic Contrast-Enhanced Magnetic Resonance Imaging of Small Bowel and Magnetic Resonance Flow Analysis of Mesenteric Vessels in Patients with Paroxysmal Nocturnal Hemoglobinuria with and without Abdominal Pain**

Sergio Margari MD (Presenter): Nothing to Disclose, Francesco Aldo De Cobelli MD : Nothing to Disclose, Giulio Pezzetti MD : Nothing to Disclose, Antonio Esposito MD : Nothing to Disclose, Alessandro Del Maschio MD : Nothing to Disclose

**PURPOSE**

The exact pathogenesis of abdominal pain in patients with Paroxysmal Nocturnal Hemoglobinuria (PNH) has never been investigated by in-vivo imaging studies. We aimed to use Magnetic Resonance Imaging (MRI) for an accurate assessment of mesenteric vessels flow and small bowel microvascular perfusion, in order to identify early pathophysiological phenomena associated with abdominal pain in PNH patients.

**METHOD AND MATERIALS**

Twelve PNH patients, six with abdominal pain (AP) and six without abdominal pain (NOP), underwent MRI in fasting conditions. Mean flow (MF) and stroke volume (SV) of Superior Mesenteric Vein (SMV) and Artery (SMA) were measured with ECG-gated phase-contrast flow-mapping sequences; mean areas under the curve at 60 (AUC60) and 90 seconds (AUC90) and Ktrans of the small intestine wall were assessed using Dynamic Contrast Enhanced MRI (DCE-MRI). Statistics were performed with Mann-Whitney test, Spearman’s correlation and linear regression model.

**RESULTS**

All MRI parameters were lower in AP than in NOP. Total AUC60: 84.81 ± 11.75 vs. 131.73 ± 18.89 (P < 0.001); total AUC90: 102.33 ± 14.16 vs. 152.58 ± 22.70 (P < 0.001); total Ktrans: 0.0346 ± 0.0019 min-1 vs. 0.0521 ± 0.0015 (P = 0.093 duodenum, 0.009 jejenum, 0.009 ileum); SMV: MF 4.67 ± 0.85 ml/s vs. 8.32 ± 2.14 (P = 0.002); SV 3.85 ± 0.76 ml vs. 6.55 ± 1.57 (P = 0.02). MF in SMV showed a positive correlation with total AUC60 (Spearman ρ = 0.882, P < 0.001), total AUC90 (ρ = 0.855, P = 0.001) and total Ktrans (ρ = 0.764, P = 0.006); linear regression analysis showed that MF in SMV was able to explain about 60-70% of MRI perfusion variability in the whole small intestine (R2 = 0.607, P = 0.005 total AUC60; R2 = 0.668, P = 0.002 total AUC90; R2 = 0.731, P = 0.011 total Ktrans). SMA: MF 6.95 ± 2.61 ml/s vs. 11.2 ± 2.32; SV 6.52 ± 2.19 ml vs. 8.76 ± 1.63 (P = 0.07).

**CONCLUSION**

Combined MR based assessment of blood flow in the mesenteric vessels and small intestine wall perfusion suggests that an impairment of small bowel blood supply is associated with the presence of abdominal pain in PNH patients. Comparing flow and perfusion parameters, MF in SMV resulted the most powerful small bowel wall perfusion independent predictor.

**CLINICAL RELEVANCE/APPLICATION**

Small intestine blood flow and perfusion impairment, especially in the venous compartment and in jejenum and ileum, seems to be an early/reliable MRI marker of mesenteric ischemia in untreated PNH patients with abdominal pain.
Frequency and Appearance of Small Bowel Image Artifacts in the Iodine Map Images of Rapid kVp Switching Dual-energy CT

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

PURPOSE

To describe the appearance and incidence of gas interface artifacts in the small bowel that may mimic bowel disease at iodine map reformations with rapid kVp switching Dual Energy CT (rsDECT).

METHOD AND MATERIALS

We retrospectively identified 99 consecutive patients (M:F = 51:48, age 59.3 ± 14.4 years) who underwent abdominal rsDECT scans obtained with oral water and IV contrast. At an AW workstation up to three representative jejunal segments in a patient were chosen to include segments with full gas-distension, partial gas-distension, or absent gas. For each jejunal segment, readers recorded the presence of image artifacts seen in the iodine maps that were not seen on the corresponding 140 kVp or 65 keV images. Iodine map artifacts were classified as: 1) Pseudo-stratified bowel wall artifact, defined as three or more thin alternating parallel bands of bright and dark signal; 2) Pseudo-pneumatosis, defined as irregular small beaded signal voids adjacent to bowel mucosa; and 3) Pseudo-hyperenhancement, defined as intense high signal of the bowel folds brighter than that of blood vessels.

RESULTS

Iodine map bowel artifacts appeared in 82 of 99 patients (83%). Of a total of 242 representative jejunal segments evaluated (full gas-distension: 54, partial gas-distension: 89, absent gas: 99), the artifacts were observed in 134 (55.4%) jejunal segments. Bowel image artifacts were more frequently seen in fully gas-distended 54 of 54 (100%) and partially gas-distended 80 of 89 (90%) jejunum than in and absent gas segments 0 of 99 (0%), p<0.001 for both. For all cases, the artifacts were seen only along the air-bowel interface. In full and partial gas-distended segments (n=143), 114 segments had two or more artifacts (totally, 105 pseudo-stratified bowel wall, 21 pseudo-pneumatosis, and 125 pseudo-hyperenhancement). The presence of pseudo-stratified bowel wall and pseudo-hyperenhancement were significantly associated (r=0.697, p = 0.02).

CONCLUSION

Image artifacts on iodine map of rsDECT are common at gas interfaces in the bowel. Knowledge of these artifacts is helpful to accurately interpret DECT scans with possible bowel disease.

CLINICAL RELEVANCE/APPLICATION

When evaluating dual energy CT iodine map images, one should recognize that gas interface artifact is common and has characteristic image appearances.
The radiological diagnosis of malignant IPMNs is controversial. The purpose of this study is to evaluate the current guidelines as a model to predict malignancy and to determine further predictors of malignancy.

**METHOD AND MATERIALS**

384 patients that had preoperative imaging (CT/MRI) and had undergone a pancreatic operation with a resulting confirmed pathological diagnosis of IPMN were included in the study. Images were evaluated retrospectively by two independent radiologists using a standardized checklist including: size, location, presence of a solid component, lymphadenopathy, parenchymal atrophy, main pancreatic duct diameter and bile duct dilation (cholestasis). Descriptive statistics, binary logistic regression and ROC analysis were performed to assess the 2012 international consensus guidelines ("Sendai criteria") and other radiological predictors of malignancy.

**RESULTS**

Analysis of the current guidelines showed a diagnostic improvement with the addition of cholestasis to the "Sendai criteria" on determining malignancy of IPMNs (sensitivity 81.2% vs. 86.9% with no change in specificity of 59.6%). The largest single predictors of malignancy were solid components (OR 7.7) and cholestasis (OR 45.6). Over 95% of all cases with cholestasis had malignant IPMNs (PPV 96.4%; NPV 63.1%). The cause of cholestasis was not solely a result of direct compression of the bile duct by the lesions. Subanalysis of branch duct IPMNs (BD-IPMNs) also resulted in a diagnostic improvement with the addition of cholestasis (sensitivity 48.8% vs. 62.8% with no change in specificity of 76.4%). The largest single predictors of malignancy for BD-IPMNs were main pancreatic duct dilation (OR 8.1) and cholestasis (OR 72.2). Frequency analysis revealed that even small BD-IPMNs had already undergone malignant transformation (≤1cm: 15%; 1-2cm: 26%; 2-3cm 20%) with about 10% of those having a dilated bile duct.

**CONCLUSION**

A dilated bile duct is a significant positive predictor of malignancy regardless of the size of the lesion. The addition of cholestasis to current guidelines is a superior tool for preoperative stratification of IPMNs.

**CLINICAL RELEVANCE/APPLICATION**

Improved radiological predictors of malignancy may offer better detection rates and in turn improved patient care.

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**SSJ09-02**

**Risk Stratification of Side Branch Intraductal Papillary Mucinous Neoplasm of the Pancreas, Based on Long-term Follow Up Results**

Ybao Liu MD, PhD (Presenter): Nothing to Disclose, Fatih Akisik MD : Nothing to Disclose, Kumaresan Sandrasegaran MD : Nothing to Disclose, Temel Tirkes MD : Nothing to Disclose, Mark Tann MD : Nothing to Disclose, Jordan K. Swensson MD : Nothing to Disclose, Chang Hong Liang MD : Nothing to Disclose, Chen Lin PhD : Research Grant, Siemens AG

**PURPOSE**

We wanted to evaluate if there is clinical value in serial imaging exams for side branch intraductal papillary mucinous neoplasm (SB-IPMN), by observing the natural history of these lesions using CT/MR imaging and ERCP/EUS data.

**METHOD AND MATERIALS**

This retrospective HIPAA-compliant study was approved by the authors' institutional review board, with waiver of informed consent. 327 patients (113 male, 214 female, mean age at time of first diagnosis, 65.95 years; range, 25-90 years) with SB-IPMN were followed up to 98 months with cross-sectional exams (CT, MRI or both) were enrolled in the study. All imaging exams, along with patients' EUS and ERCP data, were evaluated by analysis of cystic lesions including initial and final absolute sizes, absolute cyst growth rates, percentage size differences, and growth rate percentages. The differences in septation and the presence or absence of a mural nodule between CT, MRI and EUS were compared. Statistical analysis included the t test, analysis of variance (ANOVA), and McNemar test.

**RESULTS**

The mean follow up time was 40.5 months, ranging between 12 and 98 months. In the absence of a mural nodule or thick septa, no malignant tranformation was noted independent of size. Initial cyst sizes averaged 12 ± 9.0 mm with a range between 0 - 60 mm. At the end of follow up, cyst sizes averaged 14 ±10 mm. Average cyst growth was 2 ± 7 mm. Smaller cysts, <10mm, showed greater mean cyst growth rate (30%) (P

**CONCLUSION**

In side branch IPMNs smaller than 30 mm , without mural nodules or septations, we did not observe malignant tranformation on long-term follow up. Additionally, increase of cyst size did not predict malignancy. Therefore, there may be no need to perform serial evaluation of this group.

**CLINICAL RELEVANCE/APPLICATION**

If a SB-IPMN shows no mural nodule or septa , perhaps no further imaging followup is indicated, as interval change in size without these features did not predict malignancy.

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**SSJ09-03**

**Incremental Value of Secretin-Enhanced Magnetic Resonance Cholangiopancreatography in the Screening of Asymptomatic Individuals with High Risk of Pancreatic Cancer**

Neda Rastegar MD (Presenter): Nothing to Disclose, Luciana Athayde MD : Nothing to Disclose, John Eng MD : Nothing to Disclose, Naoki Takahashi MD : Nothing to Disclose, Eric P. Tamm MD : Nothing to
Natural History of Incidental Unilocular Cystic Pancreatic Lesions with >4 Year MRI Follow Up

Lyndon   Luk  MD (Presenter):  Nothing to Disclose , Tamas   Gonda :  Nothing to Disclose , Maia   Kayal :  Nothing to Disclose , Elizabeth M.   Hecht MD :  Nothing to Disclose

PURPOSE

Current literature provides limited information on the growth rate of asymptomatic cystic pancreatic lesions in patients that have had multiple abdominal MR studies over a period of at least four years. Demonstrating stability in these lesions over an extended period of time may further establish follow-up imaging guidelines.

METHOD AND MATERIALS

Keyword search of radiology reports from 2009-2013 was used to identify patients with cystic pancreatic lesions. Of the 803 patients identified, 58 had cystic lesions identifiable on MRI and >4 year imaging follow up. Two radiologists in consensus reviewed axial and coronal T2W images (5-8 mm slice thickness) and measured the single largest dimension of the largest pancreatic cystic lesion in each study. Mean interval and overall growth rate of these lesions were calculated and compared using t test (p<0.05, significant).

RESULTS

Of 202 individuals enrolled (mean age 56 years, 46% males), 93 (46%) had pancreatic cysts detected by MRCP, and 64 of the 93 had pre- and post-secretin MRCP images available for comparison. Data from the 128 readings show that 6 (6/128 = 4.7%) had ductal communication visualized only on the secretin studies compared to pre-secretin studies (odds ratio 1.28, p = 0.04). In addition, there was a statistically significant increase in confidence in reporting ductal communication after secretin compared to before secretin (p <0.0005).

CONCLUSION

At 1.5 T MRI, the use of secretin can improve the visualization of ductal communication of cystic pancreatic lesions. This incremental increase in visualizing ductal communication was also associated with increasing the reader’s confidence in making a diagnosis of IPMN.

CLINICAL RELEVANCE/APPLICATION

With 1.5 T MRI, the use of secretin improved visualization of ductal communication of a cystic pancreatic lesion in 4.6% of patients with cysts. The incremental value of secretin in screening subjects for IPMN could potentially offset the added cost and time for additional sequences. Radiologists should decide on the cost/benefit ratio of using secretin in such cases.
MR Imaging Features of Solid Pseudopapillary Tumors of Pancreas in Male Patients: Comparison with Imaging Features in Female Patients

**PURPOSE**

To evaluate and describe the imaging features of solid pseudopapillary tumors (SPT) in male patients and to compare with the imaging features of SPTs in female patients.

**METHOD AND MATERIALS**

This retrospective study was approved by the institutional review board. We included 50 patients (M:F=8:42, mean age=36.4 years) who had undergone preoperative MR evaluation and were histologically confirmed as SPT. The following MR imaging features of SPT in each patient were reviewed: size, location, shape, margin, encapsulation, hemorrhage, calcification, solid-cystic ratio, P-duct dilatation, parenchymal atrophy, T1 signal intensity, T2 signal intensity, and enhancement pattern. Statistical differences of MR imaging features between male and female SPT patients were analyzed.

**RESULTS**

The average age of male patients (50.75 ± 4.13 years) was significantly higher (p=0.0013) than female patients (33.67 ± 2.03 years). The shape of SPTs in male patients was predominantly lobulated (n=6/8, 75.0%) compared to female patients in whom oval shaped SPTs were most prevalent (n=26/42, 61.91%) (p=0.0224). SPTs in male patients were predominantly solid (solid, n=4/8, 50.0%; mainly solid, n=4/8, 50.0%) whereas cystic (n=5/42, 11.90%) or mainly cystic (n=13/42, 30.95%) lesions were significantly more prevalent in female patients (p=0.0309). Progressive heterogeneous enhancement was the most prevalent enhancement pattern of SPTs in both male (n=7/7, 100.0%) and female (n=32/37, 86.49%) patients. Other MR imaging features showed no significant difference between male and female patients.

**CONCLUSION**

In conclusion, SPTs in male patients appeared as mainly solid mass with lobulating contour and heterogeneous progressive enhancement occurring at an older age than female patients. Recognition of such different imaging features of SPTs in male patients may help to differentiate from other pancreatic tumors for proper management.

**CLINICAL RELEVANCE/APPLICATION**

SPT in male patients occurred at an older age and appeared as solid mass with lobulating contour compared to female patients.

Comparison of Diagnostic Feasibility between Ultrasound-guided Percutaneous Core Needle Biopsy and Endoscopic Ultrasound-guided Fine Needle Aspiration for Solid Pancreatic Lesions

**PURPOSE**

To compare diagnostic feasibility between endoscopic ultrasound-guided fine needle aspiration (EUS-FNA) using 25-gauge (G) needle and ultrasound-guided percutaneous core needle biopsy (USG-CNB) using 18 G core needle for the diagnosis of solid pancreatic lesion.

**METHOD AND MATERIALS**

This retrospective study was approved by our institutional review board and the requirement for informed consent was waived. Patients who underwent either EUS-FNA or USG-CNB for solid pancreatic lesion from January 2008 to December 2012 were included and reviewed. EUS-FNAs and USG-CNBs were performed by experienced endoscopists or radiologists. Technical failure rate, diagnostic accuracy, sensitivity, and specificity for malignancy were calculated and compared.

**RESULTS**

One hundred seven biopsy attempts were undertaken in 89 patients (EUS-FNA, n=71; USG-CNB, n=36). Biopsy specimens were successfully obtained in 99 biopsy attempts (EUS- FNA, n=64; USG-CNB, n=35). The technical failure rate of EUS-FNA and USG-CNB was 9.86% and 2.78%, respectively (p=0.3541). Sensitivity and specificity of EUS-FNA for malignancy was 76.36% and 88.89%, respectively, which was not significantly different (p=0.3588 and 0.6645, respectively) from sensitivity and specificity of USG-CNB (87.09% and 100%, respectively). Diagnostic accuracy was 78.13% in EUS-FNA and 88.57% in USG-CNB, which was also not significantly different (p=0.3101). Diagnostic accuracy did not differ between the two modalities according to the location of the lesion in pancreas.
CONCLUSION

The similar diagnostic performance of EUS-FNA and USG-CNB supports the use of the two modalities as a complementary utility for the accurate diagnosis of solid pancreatic lesions.

CLINICAL RELEVANCE/APPLICATION

Accurate diagnosis of lesions as benign or malignant should help clinicians establish proper treatment plans and avoid unnecessary surgery.

SSJ10

Genitourinary (MR and CT of the Urothelium)

Scientific Papers

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Participants

Moderator
Dean Akira Nakamoto MD: Research Grant, Galil Medical Ltd
Moderator
Aytekin Oto MD: Research Grant, Koninklijke Philips NV Consultant, Guerbet SA

Sub-Events

SSJ10-01

Low Iodine Content Contrast Media with Low Tube Voltage Technique in MDCT Urography: Initial Experience in Single Center

Inpyeong Hwang MD: Nothing to Disclose, Jeong Yeon Cho MD: Nothing to Disclose, Myoung Seok Lee MD (Presenter): Nothing to Disclose, Sang Youn Kim MD: Nothing to Disclose, Seung Hyup Kim MD: Nothing to Disclose

PURPOSE

The aim of the present study was to investigate the image quality and feasibility of CT urography with low iodine concentration (240 mg/mL) contrast media and low (80 kVp) tube voltage with iterative reconstruction algorithm.

METHOD AND MATERIALS

This prospective study enrolled 63 patients who underwent CT urography. The subjects were randomized into two arm of excretory phase CT urography protocol; 480 seconds after intravenous injection of 1.5 mL/kg of ioversol with concentration of 240 mg/mL (low-concentration protocol, n = 29) or 350 mg/mL (conventional protocol, n = 26). In low-concentration protocol, tube voltage was reduced to 80 kVp (120 kVp in conventional protocol) to increase attenuation value, and iterative reconstruction algorithm were used to reduce the noise. Two genitourinary radiologists were qualitatively evaluated images with 5-point scale for overall diagnostic acceptability. Mean attenuation, signal to noise ratio (SNR), contrast to noise ratio (CNR) and figure of merit (FOM = CNR² / effective dose) were measured at urinary tract. Mean image noise were measured at background tissue. Mann Whitney U test were used to compare quantitatively measured values and qualitative rated scores.

RESULTS

In terms of radiation dose, low-concentration protocol showed significantly lower effective dose (3.4 vs. 5.7 mSv, P < .001). Subjective diagnostic acceptability was significantly lower in low-concentration group (4.1 ± 0.5 vs. 4.5 ± 0.4, P < .001). However, all subjects showed more than standard diagnostic acceptability (score ≥ 3) in each group. Mean image noise showed no significant difference (15.0 vs. 14.3, respectively, P = .243). SNR, CNR and FOM were significantly higher at all segments of urinary tract in low-concentration protocol (P = .004 for CNR of left lower ureter, P = .005 for CNR of urinary bladder, P < .001 for all other values).

CONCLUSION

Image quality of CT urography with 240 mgI/mL iodine content contrast media, 80 kVp tube voltage and iterative reconstruction algorithm were lower than conventional protocol. However, it showed higher CNR and FOM, and its diagnostic acceptability were still maintained above standard quality. Therefore it can be performed for clinical use to reduce total amount of iodine and radiation dose.

CLINICAL RELEVANCE/APPLICATION

Considering risk of contrast-induced nephropathy and radiation, low iodine content contrast media with low tube voltage CT urography might be beneficial.
Learning T Staging and Grading of Bladder Tumor with 3.0 T MR: The Combination of T2WI, Dynamic Enhancement and DWI

Yang Wang (Presenter): Nothing to Disclose, Hongqian Guo: Nothing to Disclose, Bin Zhu: Nothing to Disclose

PURPOSE
To evaluate bladder tumors using high-b-value diffusion imaging and compare imaging features to pathological results on 3.0 T MR.

METHOD AND MATERIALS
Approval for the study was obtained from the local institutional review board. 163 consecutive patients were prospectively enrolled. The population included 142 (87.1%) men (mean age, 65.2 years) and 21 (12.9%) women (mean age, 65.8 years). We evaluated the sensitivity, specificity, positive predictive value (PPV), negative predictive value, and accuracy of DW, DCE and T2-weighted MR images as aids in the identification of bladder tumors, abnormal bladders. A comparison of imaging findings with the results of cystoscopy and histologic examination was subsequently performed by using the McNemar test. A P value of less than .05 was considered to indicate a statistically significant difference.

RESULTS
Specificities obtained by using T2-weighted plus DW images, DCE plus DW images or all three image types together were significantly better than that obtained by using T2-weighted images alone (P = .004, .003 and .001, respectively). Sensitivity obtained by using T2-weighted plus DW images, DCE plus DW images or all three image types together were significantly better than that obtained by using T2-weighted images alone (P = .04, .02 and .003, respectively). The number of Ta with papillary archlike shape on DWI were majority. In contrast, the number of T1 with sessile were majority. The differences in ADC were significant between low-grade and high-grade (P < .01).

CONCLUSION
The method of T2WI, DWI plus DCE images provided useful information for evaluating the T stage in bladder tumors. Some imaging features of bladder tumors to distinguish Ta from T1 bladder tumors were presented.

CLINICAL RELEVANCE/APPLICATION
1. More accurate imaging information could be contributed to the bladder tumors with 3.0T MRI.
2. Some imaging features of bladder tumors to distinguish Ta from T1 bladder tumors were presented.

Multi-parametric MRI Staging of Bladder Urothelial Carcinoma

Huanjun Wang MD (Presenter): Nothing to Disclose, Yan Guo MD: Nothing to Disclose, Shurong Li: Nothing to Disclose, Jian Guan MD: Nothing to Disclose, Xiaoling Zhang: Nothing to Disclose, Mingjuan Liu MMEd: Nothing to Disclose

PURPOSE
To determine an optimal multi-parametric MRI protocol for preoperative staging of bladder urothelial carcinoma.

METHOD AND MATERIALS
The study was approved by the institutional ethics committee and informed consent was obtained from all patients. Enrollment requirement: patients with suspected or confirmed urothelial bladder cancer and no renal function impairment. Exclusion criteria: patients without histopathologic confirmation and tumors smaller than 1cm. Thirty-nine patients underwent conventional, diffusion-weighted (DW) and dynamic contrast-enhanced (DCE) MRI within one week before surgery. Three image sets of T2WI and DW-MRI, T2WI and DCE-MRI, and T2WI and DCE-MRI and DW-MRI were independently interpreted by two readers at 2-week intervals. Diagnostic efficacy of detrusor muscle invasion by cancer was compared among the three image sets. The apparent diffused coefficient (ADC) values were correlated with histopathologic grading.

RESULTS
54 urothelial carcinomas (36 T1, 13 T2, 1 T3 and 4 T4 stages) in 33 patients were analyzed. Receiver operating characteristic (ROC) curves were plotted for both readers to compare the diagnostic efficacy of the three image sets for detrusor muscle invasion and the area under the ROC curve were compared using Bonferroni test. The ADC values of 11 high-grade carcinomas were significantly lower than those of 20 low-grade carcinomas. Using the cutoff ADC value of 0.899 x10-3 mm²/s, the sensitivity and specificity for differentiating high- and low-grade bladder urothelial carcinoma were 100% and 95%, respectively.

CONCLUSION
Multi-parametric MRI with T2WI, DW-MRI and DCE-MRI is the optimal imaging protocol for preoperative staging of bladder urothelial carcinoma. The ADC of low-grade tumor is significantly higher than that of high-grade bladder malignancy with 100% sensitivity and 95% specificity at cutoff ADC value of 0.899 mm²/s.
CLINICAL RELEVANCE/APPLICATION

Multi-parametric MRI with T2WI, DW-MRI and DCE-MRI is the optimal imaging protocol for preoperative staging of urothelial bladder cancer. The ADC of low-grade tumor is significantly higher than that of high-grade bladder malignancy.

SSJ10-04

MDCT Urography in Detecting Recurrence after Transurethral Resection of Bladder Cancer: Comparison of Nephrographic Phase with Pyelographic Phase

See Hyoung Kim: Nothing to Disclose, Yujin Yeo (Presenter): Nothing to Disclose

PURPOSE

We prospectively compare nephrographic phase (NP) MDCT urography using oral hydration and a diuretic with the standard pyelographic phase (PP) for detecting recurrence after transurethral resection (TUR).

METHOD AND MATERIALS

We included 140 MDCT urography examinations in 121 patients (87 men and 34 women; range, 46-88 years) who had a risk for recurrence of urinary tract. MDCT urography after contrast injection was performed at 60 seconds NP and 420 seconds PP. Two radiologists independently recorded recurred lesion for each phase. Standard of reference was obtained from histology and prospective clinical decision. Distention and opacification were compared for each radiologist in each segment in each phase by kappa and Spearman rank coefficients. Generalized estimating equations for logistic regression were used to compare performance in each radiologist and phase, and adjusted for possibility within patient correlation.

RESULTS

Urinary tract distention was rated significantly better at the PP for all segments (P < 0.001). The degree of pacification provided by each radiologist for the same segment showed high correlation. There were 59 bladder and 19 upper tract recurrences in 38 and 13 patients. For recurrence detection in bladder, the overall accuracy was significantly higher the NP than the PP (91.9% (354/386) vs. 83.2% (321/386), P = 0.038). For recurrence detection in upper tract, the overall accuracy was significantly higher the NP than the PP [86.7% (260/300) vs. 80.2% (240/300), P = 0.028].

CONCLUSION

NP MDCT urography has higher detection in recurrence than the PP, which suggests indispensable use for evaluating the urinary tract after TUR.

CLINICAL RELEVANCE/APPLICATION

It is impractical to perform follow-up cystoscopy or ureteroscopy on all the patients after TUR. NP with sufficient distention perhaps could be of help to use invasive modality properly and to reduce the number of studies needed to diagnose recurrence.

SSJ10-05

Can Nephrographic Dual-energy CTU Replace Three-phase CTU?

Byung Kwan Park MD (Presenter): Nothing to Disclose, Jung Jae Park MD: Nothing to Disclose, E-Ryung Choi MD: Nothing to Disclose

PURPOSE

To retrospectively evaluate nephrographic dual energy CT (DECT) with virtual non-contrast CT (VNCT) compared to three-phase CT urography (CTU) in patients with hematuria.

METHOD AND MATERIALS

A total of 296 consecutive patients (167 men and 129 women; mean age, 57.9±13.5 years) received three-phase (120 kvp non-contrast and 140/80 kvp nephrographic and excretory) CTU using DECT technique due to hematuria between September 2009 and August 2012. Two genitourinary radiologists independently evaluated three-phase CTU scans first and then, nephrographic DECT with VNCT. Sensitivity, specificity, and accuracy on three-phase CTU and nephrographic DECT were calculated and compared for detecting urothelial tumor. Stone detection rate and dose-length product (DLP) were compared between VNCT and three-phase CTU. Standard reference of urothelial tumor was biopsy or surgery and that of stone was 120 kvp unenhanced CT. DLP was automatically recorded on the patient protocol of each CT scan. McNemar test and paired t-test were used between DECT or VNCT and three-phase CTU for statistical analysis.

RESULTS

Of 296 patients, 27 tumors in 20 patients were pathologically confirmed. On three-phase CTU, 26 tumors in 19 patients and 148 stones in 64 patients were detected. On nephrographic DECT with VNCT, 24 tumors in 19 patients and 108 stones in 56 patients were detected. Sensitivity, specificity, and accuracy for tumor on three-phase CTU were 95% (19/20), 98.9% (273/276), and 98.6% (292/296), respectively (p>0.1). A total of 148 stones were detected on 120 kvp unenhanced CT. On VNCT images obtained from nephrographic DECT scan, 108 (73%) stones were detected, respectively. On VNCT from nephrographic DECT, mean sizes of detected and undetected stones were 5.0±3.5 mm and 1.5±0.5 mm, respectively (p<0.0001). Mean DLP of nephrographic (410±98 mGy•cm) was significantly lower than that (1076±248 mGy•cm) of three-phase CTU (p<0.0001).
CONCLUSION

Nephrographic DECT has potential to replace three-phase CTU for detection of urothelial tumor using much lower radiation dose. However, this single-phase DECT can miss a significant number of small stones that are detected on 120 kvp unenhanced CT.

CLINICAL RELEVANCE/APPLICATION

Nephrographic contrast-enhanced DECT is recommended for evaluating hematuria in patients who are high risk for urothelial tumor.

SSJ10-06

Can Diffusion Weighted MRI including ADC Values Predict the Response of Bladder Tumor to the Chemo-radiotherapy?

Mohamed Abou El-Ghar MSc, MD (Presenter): Nothing to Disclose, Huda Refaie MD: Nothing to Disclose, KHALED ZAKY SHEIR MD: Nothing to Disclose, Abdallah Abdelhamid Abdelaziz MBCh: Nothing to Disclose, Hashim Mohamed Farg MBCh: Nothing to Disclose, Tarek A. El-Diasty MBCh, MD: Nothing to Disclose

PURPOSE

To evaluate the role of diffusion weighted (DW) MRI in prediction of bladder tumor response to chemo-radiotherapy.

METHOD AND MATERIALS

the study included 38 patients with fifty bladder tumors under follow up during chemo-radiotherapy for bladder tumor. The patients were followed up to 4 years and the tumor response including changes in the size after the chemo-radiotherapy. All of our patients underwent MRI before and after management, the restricted diffusion and the ADC values were calculated at every study.

RESULTS

Among our patients; the group treated with chemo-radiotherapy showed good response in 25 masses with tumor size reduction or resolution of the tumor, while in the other 25 masses there were no or increase in the tumor size with no statistical difference in the pretreatment ADC values between both groups but diffusion can detect the presence or absence of tumor after treatment with high sensitivity and specificity in comparison to cystoscopy. The range and[mean and standard deviations] of the ADC values (×10-6 mm²/sec) in the masses respond to chemo-radiotherapy were 102-1360 [549+ 436], and for the other group that not respond to the chemo-radiotherapy were 103-970[394+352], p=0.425. In the patients group who respond to chemo-radiotherapy there were significant decrease in the ADC value of the mass from the pretreatment values, its range and[mean and standard deviations] of the ADC values (×10-6 mm²/sec) were 111-1730 [1791 + 2579] and p=0.009.

CONCLUSION

The pretreatment DWI with ADC map can’t predict the response to chemo-radiotherapy but the can detect the residual lesions accurately also there is increase in the post-treatment ADC values in cases respond to chemo-radiotherapy in comparison to the pretreatment values.

CLINICAL RELEVANCE/APPLICATION

bladder tumor is a common problem in egypt and we use a DWI as a fast study to predict tumor response to chemo-radiotherapy and to evaluate the the changes of ADC in case of tumor response to the chemo-radiotherapy
**SSJ11-02**

Functional MRI to Detect Metastases in Normal-sized Pelvic Lymph Nodes: Which Technique Is the Best?

Harriet Carolina Thoeny MD (Presenter): Nothing to Disclose, Maria Triantafyllou: Nothing to Disclose, Giuseppe Petralia MD: Nothing to Disclose, Johannes M. Froehlich PhD: Consultant, Guerbet SA

**PURPOSE**

To prospectively compare the diagnostic performance of 3 functional MRI methods (ultrasmall superparamagnetic particles of iron oxide-enhanced MRI(USPIO); diffusion-weighted MRI(DWI); combined USPIO / DWI (USPIO-DWI)) to detect pelvic lymph node (LN) metastases in normal-sized nodes.

**METHOD AND MATERIALS**

A consecutive series of 75 pts with bladder (n=19), prostate cancer (n=48) or both (n=8) and normal-sized LNs on crosssectional imaging underwent two separate MRI exams of the pelvis at 3T after written informed consent. Imaging included T1- and T2- 3D-sequences with isotropic voxels of 0.75/1 mm3, respectively and transverse DWI of the entire pelvis ( 3b-values: 0,500,1000sec/mm2). After the first MRI USPIO (2.6mg Fe/kg bw) was administered i.v. followed by a second MRI with the identical protocol 24-36 hrs thereafter. All pts underwent template lymphadenectomy. Image analysis was performed by 3 different independent readers separately for all 3 functional methods. Results of the mean diagnostic performance were reported on a per patient basis for each method separately and correlated to histopathology.

**RESULTS**

A total of 2993 LNs were resected and 54 metastatic LNs were detected in 20/75 pts (26.7%) on histopathology. On a per patient level the readings of each of the 3 methods yielded the following mean diagnostic results: sensitivity: USPIO= 58.5%, DWI=78.9%, USPIO-DWI= 70.0%; specificity: USPIO=83%, DWI=81.5%, USPIO-DWI=94%; PPV: USPIO=58%, DWI=58.9%, USPIO-DWI=80.8%; NPV: USPIO=84.4%, DWI=92.1%, USPIO-DWI=89.6%; diagnostic accuracies: USPIO=76.4%, DWI=80.9%, USPIO-DWI=87.6%, respectively. The vast majority of the missed metastases had a short axis diameter < 5mm on histopathology. The false positive LNs attributed on USPIO and DWI were mainly due to fibrosis, lipomatosis or histiocytosis.

**CONCLUSION**

DWI allows detection of LN metastases in normal-sized LNs without contrast medium administration in a high number of pts. USPIO-DWI further decreases the number of false positive LNs and facilitates reading, however needs contrast medium at the expense of higher costs and invasiveness. USPIO alone is inferior and is therefore not recommended.

**CLINICAL RELEVANCE/APPLICATION**

Improvement of LN staging in normal sized LNs would allow to omit extended pelvic LN dissection in case of negative findings. It would allow to guide the surgeon in case of suspicious LNs or change treatment to adjuvant chemotherapy or hormonal therapy instead of surgery alone.

**SSJ11-03**

Characterization of Lymph Node Metastases Using Diffusion-weighted MRI in Cases of Bladder Cancer

Mohamed Abou El-Ghar MSc, MD (Presenter): Nothing to Disclose, Ahmed Adel Mansour BMedSc: Nothing to Disclose, Huda Refaie MD: Nothing to Disclose, Tarek A. Diasty MBBCh, MD: Nothing to Disclose

**PURPOSE**

To assess the utility of Diffusion weighted MRI (DWI) including apparent diffusion coefficient (ADC) for distinguishing lymph nodes harboring metastatic disease in bladder cancer patients.

**METHOD AND MATERIALS**

The study cohort included 138 patients who underwent MRI with diffusion weighted imaging prior to radical cystectomy between April 2012 and May 2013. ADC values were measured in a circular region of interest where lymph node enlargement was found. Two radiologists blinded to the pathologic outcome interpreted the DW images. All patients underwent radical cystectomy with bilateral extended lymphadenectomy extending above the bifurcation of the common iliac vessels. Anatomical mapping of the removed lymph nodes was performed intraoperatively and the nodes were sent in separate packages for pathological assessment. Qualitative analysis of lymph nodes ans the ADC values obtained from the enlarged lymph nodes were then correlated with the final pathological assessment of the resected lymph nodes.

**RESULTS**

One hundred and thirty eight patients were evaluated by DW-MRI. Patients with radiological lymph node enlargement were identified (n=88, 63%), ADC values were calculated in areas of lymph node enlargement in four anatomical regions on each side, namely, common iliac, external iliac, internal iliac and obturator regions. Mean(SD) ADC value was 1.06 (0.2) x10-3 mm2/s. There was a significant difference in ADC values of metastatic lymph nodes and areas of negative node involvement (p=0.0012). ROC analysis identified an optimal ADC threshold of 1.25 x10-3 mm2/s for identifying the presence or absence of metastatic disease. Qualitative analysis shows no difference between metastatic and non-metastatic lymph nodes.

**CONCLUSION**

Our results suggests that DW-MRI ADC values correlate with the presence of metastatic disease in patients with bladder cancer and radiologically enlarged lymph nodes. Qualitative analysis shows fluid restriction in both metastatic and non metastatic nodes.

**CLINICAL RELEVANCE/APPLICATION**
SSJ11-04

Pilot Study to Evaluate the Use of Full-body MRI for Tumor Detection in Asymptomatic Subjects with Succinate Dehydrogenase B (SDHB) Gene Mutations

Mark Alan Rosen MD, PhD (Presenter): Nothing to Disclose, Katherine Nathanson: Nothing to Disclose, Lauren Fishbein: Nothing to Disclose, Laurie A. Loevner MD: Nothing to Disclose, Shana Merrill: Nothing to Disclose, Debbie Cohen: Nothing to Disclose

PURPOSE

To evaluate the potential for rapid full-body MRI to identify occult tumors in asymptomatic subjects with SDHB gene mutations, a population at risk for pheochromocytoma/paraganglioma (PCC-PGL).

METHOD AND MATERIALS

Asymptomatic and previously unaffected SDHB gene mutation carriers underwent full-body MRI scanning of the neck, chest, abdomen, and pelvis (NCAP) using a modified rapid full body imaging sequence. Scanning was performed on a 1.5 Tesla imaging unit (Espree®, Siemens, Erlangen, GE) equipped with continuous table movement (CTM) software for rapid large volume imaging. Imaging included four axial sequences (T2 HASTE, T2 HASTE with fat suppression, and T1 DIXON chemical shift imaging before and after gadolinium administration) from the skull base through the pelvis, supplemented with step-table diffusion weighted imaging. Positive findings were correlated with pathological data.

RESULTS

Twenty previously unaffected SDHB carrier subjects underwent a total of 22 whole body MRI examinations. Single solid masses were identified in 6 subjects, for an overall positive screen rate of 6/22, or 27%. In 5/6 positive cases (PPV=83%), pathology confirmed presence of a paraganglioma (N=3) or another clinically significant tumor (N=2). Two retroperitoneal paraganglioma were identified, 2.3 and 5.4 cm, respectively. The larger lesion demonstrated vascular invasion and increased mitotic activity. One para-urethral paraganglioma (1.5 cm) was also identified. Pathology in the remaining two positive cases included a 2 cm typical carcinoid tumor in the lung and an 8 cm unclassified RCC. In one false positive case, a 1.8 cm retrocrural mass demonstrated indeterminate results on endoscopic FNA.

CONCLUSION

Rapid full-body MRI scanning using continuous moving table techniques is feasible as a screening study in patients at risk for tumors in various locations. Application to an asymptomatic population of SDHB mutation carriers can readily demonstrate clinically significant tumors.

CLINICAL RELEVANCE/APPLICATION

Rapid full-body MRI allows for clinical evaluation of the neck, chest, abdomen, and pelvis and demonstrates clinically relevant findings in a high percentage of SDHB mutation carriers.

SSJ11-05

Can Radiologists Prevent Unnecessary Orchitectomies? Role of Multiparametric Ultrasonography in Facilitating Testis - Sparing Surgery

Dean Yi-Hsiang Huang MBBS, FRCP (Presenter): Nothing to Disclose, Eleni Konstantatou MD, MSc: Nothing to Disclose, Robert John Eckersley PhD: Nothing to Disclose, Maria E. Sellers MD, FRCP: Nothing to Disclose, Paul Singh Sidhu MRCP, FRCR: Speaker, Bracco Group Speaker, Siemens AG Speaker, Hitachi, Ltd

PURPOSE

The availability of scrotal ultrasonography has led to an increasing number of incidentally detected intra-testicular lesions, resulting in a number of unnecessary orchidectomies. Testis-sparing surgery (TSS) is the preferred option when there is a possibility of a benign lesion. We aim to evaluate the role of pre-operative multiparametric ultrasonography (MP-US), which include gray-scale and color Doppler sonography combined with contrast-enhanced ultrasound (CEUS) and real time elastography (RTE), in facilitating case selection for patient selection for testis - sparing surgery.

METHOD AND MATERIALS

Consecutive patients undergoing surgery for testicular lesions between 2010 and 2013 were studied. All lesions were assessed with MP-US pre-operatively and consensus imaging and clinical assessments were made at a multi-disciplinary meeting for suitability for TSS. Patient demographics, tumour characteristics and histological outcomes were recorded. Oncological outcome in the TSS group was assessed with follow-up ultrasound.

RESULTS

51 patients who had either orchidectomy or TSS were studied. 12 patients (median 39 years, range 24 - 48) underwent TSS for 13 testicular lesions (median size 6 mm, range 3.3 - 15 mm). 38 patients (median age 40 years, range 19-84) underwent orchidectomy for 38 lesions (median size 20.5 mm, range 7-50). All malignancies were correctly identified pre-operatively on MP-US. Histopathological findings for all 13 lesions selected for TSS confirm no malignant features, with final diagnosis including Leydig cell tumours (6), Epidermoid cysts (2), Sertoli cell tumour (1), sarcoidosis (2), focal testicular atrophy (1) and Leydig cell hyperplasia (1). The sensitivity, specificity, positive predictive value and negative predictive value of MP-US for
a benign lesion suitable for TSS are 96.3%, 92%, 92.86% and 95.8% respectively. Oncological follow-up reveals no disease recurrence in all patients in TSS group at 12 months.

CONCLUSION
Our experience suggests that multi-parametric ultrasonography could be a valuable non-invasive investigation to predict benign testicular disease, and improve pre-operative diagnostic confidence to allow testis-sparing surgery to be considered.

CLINICAL RELEVANCE/APPLICATION
Multi-parametric ultrasonography could improve pre-operative diagnosis of testicular lesions. Clinicians should be aware of this possibility so unnecessary orchiectomies may be prevented.

SSJ11-06 Diffusion Weighted Imaging of Testicular Tumors – Is there a Value for Differentiation between Benign and Malignant?
Emina Talakic MD (Presenter): Nothing to Disclose, Sebastian Tschauner: Nothing to Disclose, Helmut Schoellnast MD: Nothing to Disclose, Tillich Manfred: Nothing to Disclose

PURPOSE
To assess the value of diffusion-weighted imaging (DWI) for differentiation between benign and malignant solid testicular tumors.

METHOD AND MATERIALS
This retrospective study was IRB approved and the requirement for patient informed consent was waived. A search of the medical databases 2011 / 2012 yielded 25 patients (mean age ± SD, 48 ± 14 yrs; range, 21-76 yrs) who underwent MRI with DWI of the testes for evaluation of a mass which was detected with ultrasound. The mean apparent diffusion coefficient (ADC) and the standard deviation (SD) of the ADC were recorded for each tumor using ROI measurements to assess both, mean ADC of the tumor and heterogeneity of ADC within the tumor. Histopathology or clinical follow-up was used to define the definitive diagnosis. The K-S test and the unpaired t-test were used to assess normal distribution of the values and to compare differences in mean ADC and mean SD of ADC between benign and malignant tumors. A p-value <.05 was considered statistically significant.

RESULTS
Histopathology revealed malignancy in 8 tumors and no evidence of malignancy in 4 tumors. In the remaining 13 tumors, malignancy was ruled out by clinical and imaging follow-up. The mean ADC of benign tumors was 1.54 x 10^-3 mm^2/sec and the mean ADC of malignant tumors was 1.56 x 10^-3 mm^2/sec. The mean SD of the ADC was 1.15 for benign and 1.38 x 10^-3 mm^2/sec for malignant tumors. The differences in means were not statically significant.

CONCLUSION
Benign and malignant testicular tumors showed similar mean ADC values and SD of ADC values indicating comparable cell density and tissue homogeneities between the tumors. Therefore, DWI may not enable differentiation between benign and malignant testicular tumors.

CLINICAL RELEVANCE/APPLICATION
'Diffusion-weighted (DW) MR imaging is a technique proved to improve tissue characterization and could be used in the detection and characterization of testicular tumors.'
**SSJ12-02  Prevalence and Significance of Incidentally Noted Dilation of the Thoracic Aorta on Screening Chest CT**

Nancy J. Benedetti MD (Presenter): Nothing to Disclose, Michael D. Hope MD: Nothing to Disclose

**PURPOSE**

With the commencement of lung cancer screening in the United States, the discovery of incidental thoracic findings, such as ascending aortic dilation, will become more common. Current guidelines recommend yearly CT follow-up for ascending aortas measuring 4.0-5.0 cm. However, little is known about patient outcomes in this population. We conducted a study to determine the incidence of incidental ascending aortic dilation and to determine the rate of change in aortic diameter over time in 55-80 year olds (lung cancer screening population). The objective of this study is to inform guidelines on follow-up of incidental ascending aortic dilation.

**METHOD AND MATERIALS**

We searched 88,171 chest CT scans done on 31,963 patients aged 55-80 years old at our institution over a 14 year period (2000-2013) and determined the incidence of incidental ascending aortic dilation (4.0-5.0 cm). Patients were excluded if they had a known/repaired aortic aneurysm or dissection, mycotic aneurysm or history of connective tissue disease. For patients with at least 2 CT scans ≥6 months apart, we determined the growth rate of the aorta. We also conducted a chart review to assess for complications or vascular surgery interventions.

**RESULTS**

In our study sample of 25,039 patients after exclusions, we found a 2.7% incidence (n=678) of incidental ascending aortic dilation. Of the 678 patients with aortic dilation, 333 patients had follow-up studies with 3.3 years average length of follow-up between chest CT examinations. In the population of patients with follow-up studies, only 2.7% (n=9) demonstrated interval growth of 3 to 7 mm over a time period of 1.5 to 7.5 years (average growth of 1.1 mm/year). None of these patients had complications (e.g. dissection, rupture) or surgical intervention.

**CONCLUSION**

Current guidelines recommend yearly follow-up of patients with incidental ascending aortic dilation in the 4.0-5.0 cm range. However, we found aortic growth in only 2.7% of patients, a slow growth rate of 1.1 mm/year and no complications.

**CLINICAL RELEVANCE/APPLICATION**

Current guidelines could be revised to:

1. Increase the interval between follow-up studies
2. Incorporate risk stratification to determine which patients would benefit most from yearly follow-up and which could safely be followed at longer time intervals.

**SSJ12-03  Patient-Centered Treatment Selection for Small Renal Masses Using Nephrometry Score and Renal Function: A Comparative Effectiveness Study**

Stella Kang MD: Nothing to Disclose, Pari Pandharipande MD, MPH (Presenter): Nothing to Disclose

**PURPOSE**

The current standard of care for small renal masses is partial nephrectomy (PN), but concern has been raised over consequent renal functional decline. In patients with chronic kidney disease (CKD), we compared life expectancy (LE) after PN to that after a treatment strategy in which patients were triaged to percutaneous ablation vs. PN based on renal function and Nephrometry Score (NS), a tumor anatomy scoring system.

**METHOD AND MATERIALS**

We developed a decision-analytic Markov model to project LE in hypothetical patients with mild or moderate CKD undergoing treatment of small renal masses. Our model incorporated NS, which correlated with tumor anatomy predictive of post-surgical renal functional loss. Tested strategies were: 1) nonselective PN; and 2) selective PN, with triage to percutaneous ablation for moderate CKD and any NS, or for mild CKD and high NS, and otherwise PN. The model accounted for benign and malignant lesions, renal functional decline after each treatment type, mortality rates by CKD stage, Charlson comorbidity index, tumor NS distribution, and local recurrence and metastatic disease rates for each treatment. Patients were susceptible to all-cause mortality, surgical mortality, and cancer-specific mortality. Our primary model outcome was LE. We used sensitivity analysis to determine the stability of results when varying key parameters.

**RESULTS**

Nonselective treatment with PN of 65-year-old men (mean age of renal cell cancer diagnosis) resulted in an average decrease in LE of 0.46 years (11.0 to 10.54 years) relative to selective PN, due to worsening CKD and associated cardiovascular mortality. 65-year-old women experienced an average LE loss of 0.56 years (12.7 to
12.14 years). Among all parameters, model results were most sensitive to variability in the rate of renal function decline and CKD-related mortality.

**CONCLUSION**

Renal mass ablation is likely to be the most effective strategy for treatment of small renal masses in patients with baseline moderate CKD, or with mild CKD and complex tumor anatomy.

**CLINICAL RELEVANCE/APPLICATION**

Renal mass ablation may be a more effective treatment option for small renal masses than partial nephrectomy in patients with moderate CKD or with mild CKD and complex tumor anatomy.

**SSJ12-04**

**Agreement Studies in Radiology Research**

Behzad Farzin MD (Presenter): Nothing to Disclose, Jean-Christophe Gentric: Nothing to Disclose, Olivier Naggara MD: Nothing to Disclose, Jean Raymond MD: Nothing to Disclose

**PURPOSE**

Guidelines to improve reporting of reliability and agreement studies in health care were proposed by Kottner et al., in 2011 (GRRAS). We hypothesized that rater agreement studies reported in the radiology literature were suboptimal. Our purpose was to assess how agreement studies were designed and reported in our field, and identify areas for improvement.

**METHOD AND MATERIALS**

We conducted a retrospective assessment of all articles published in 4 selected journals (Radiology, AJNR, CARJ, Journal de Radiologie; from January 2011 to December 2012). Editorials, commentaries, review articles and references to published studies were excluded. Four trained adjudicators independently evaluated pertinent articles using a 23-item form that included the 15 GRRAS criteria. One senior author reviewed all report forms.

**RESULTS**

Of 2229 source articles, 951 titles were identified, and after manual exclusion, 280 articles (12.6% of total) were found that reported agreement or reliability studies. The mean number of subjects per study was 81 ± 99. Justification for the sample size was found in 9 studies (3.2%). The number of raters was = 20 patients, and v) mention of agreement in the discussion section, was present in 4 studies (1.4%). Radiology articles dedicated to agreement were few in number (20 or 0.9%).

**CONCLUSION**

In spite of their importance, agreement studies are few, incompletely reported and commonly offer a cursory assessment of reliability. There are many potential research opportunities for studies of this type, which should be promoted at all levels.

**CLINICAL RELEVANCE/APPLICATION**

The demonstration of robust intra- and inter-observer agreement or reliability in well-designed studies is essential, before dissemination of diagnostic technologies or the widespread use of diagnostic criteria, to prevent improper clinical decisions.

**SSJ12-05**

**Utilization of Pre-operative Imaging for Muscle Invasive Bladder Cancer: A Population-based Study**

Matthew Donald Fernand McInnes MD, FRCP (Presenter): Nothing to Disclose, David Robert Siemens: Nothing to Disclose, William Mackillop MD: Nothing to Disclose, Yingwei Peng PhD: Nothing to Disclose, Shelly Wei: Nothing to Disclose, Nicola Schieda MD: Nothing to Disclose, Christopher M. Booth MD, FRCP: Nothing to Disclose

**PURPOSE**

To describe the use of pre-operative imaging for muscle-invasive bladder cancer and to evaluate the association between imaging and patient outcome in routine clinical practice.

**METHOD AND MATERIALS**

In this IRB-approved, population-based cohort study, electronic records of treatment were linked to the Ontario Cancer Registry to identify all patients with bladder cancer treated with cystectomy in Ontario from 1994-2008. Utilization of various chest, abdomen, pelvis and bone imaging strategies was evaluated over time. Temporal trends were evaluated over 3 study periods (1994-1998, 1999-2003, and 2004-2008). Logistic regression was used to analyze factors associated with imaging utilization. Cox model analyses were used to explore associations between imaging and survival.

**RESULTS**

2802 patients with MIBC underwent cystectomy during 1994-2008. Utilization increased over the 3 study periods: chest x-ray (CXR) (55%, 64%, 63%, p<0.001), CT chest (10%, 10%, 21%, p<0.001), bone scan (30%, 34%, 36%, p=0.04) and CT, US or MR of the abdomen and pelvis (85%, 90%, 92%, p<0.001). Use of chest and bone imaging was independently associated with age, N-stage, surgeon cystectomy volume, and
geographic region. In adjusted analyses we found inferior outcomes among patients who did not have pre-operative chest imaging (CXR or CT): Overall survival (OS) hazard ratio (HR) 1.12 (95%CI 1.01-1.25), cancer specific survival (CSS) HR 1.09 (0.97-1.22); or bone scan OS HR 1.11 (1.01-1.22), CSS HR 1.09 (95%CI 1.01-1.25). No benefit for CT chest over CXR was identified.

CONCLUSION

In routine clinical practice, there is considerable variation in use of pre-operative chest, body, and bone imaging. Pre-operative chest and bone imaging is associated with improved outcomes. No survival benefit for CT chest over CXR was identified. This association likely reflects better patient selection for cystectomy.

CLINICAL RELEVANCE/APPLICATION

Pre-operative chest and bone imaging to stage muscle-invasive bladder cancer is associated with improved outcomes. This association likely reflects better patient selection for cystectomy.
**Why Real-time-Monitoring Could Be the Key to Workflow Optimization in Radiology**

**Achim Escher (Presenter): Nothing to Disclose**, **Tobias Heye MD**: Nothing to Disclose, **Elmar M. Merkle MD**: Advisor, Siemens AG Advisor, Bayer AG Speakers Bureau, Bayer AG Research Support, Bracco Group Research Support, Guerbet SA

**CONCLUSION**

A real-time-monitoring approach can help to optimize the radiology workflow by making essential process steps and related information available to the staff.

**Background**

To optimize service quality web-based-monitoring-displays were implemented in 2013/2014. Displays are showing lists of pending studies in critical workflow-steps (protocoling, scheduling, reporting). The goal is time tracking each workflow-step to ensure timely processing to prevent unnecessary delays. Color-coded time thresholds help to adhere to process time objectives. In a further step this monitoring-approach was used to optimize communication between the emergency room (ER) and radiology department. Status update information for each process-step were broadcasted to a central display at the ER.

**Evaluation**

Protocoling: 2013 data showed a high variability in the mean time period between order entry and protocoling (range 50-76 min.) which decreased from 75 min. to 52 min. (2/2014 vs. 3/2014) following the implementation of the monitoring solution. Scheduling: A high variability in the mean scheduling processing time (range 14-36 min.) was improved by 18 minutes from 2/2014 to 3/2014. Reporting: Since the introduction of real-time-monitoring turnaround-times (TAT) for radiology reports in 6/2013, the median of TAT improved by 100 min. compared to 6 months prior and by 278 min. compared to 2012. Information system in the ER: The patient’s status within the radiology scheduling system was displayed in the ER to allow optimized patient management e.g. discharging if an MRI study was arranged. This led to an increase in MRI study referrals (mean before 6.8/week, mean after optimization 15.6/week).

**Discussion**

Previously high variability in workflow steps indicate an opportunity in workflow optimization and reveal organizational issues causing prolonged process steps. To ensure fast processing of each workflow step color-coded indicators to identify critical time period thresholds are helpful. Real-time-monitoring can help to improve service quality for referring physicians by offering transparency and providing information about the patients’ status within the radiology workflow at any time.

**Can We Predict Patient Waiting Time?**

**Oleg S. Pianykh (Presenter): Nothing to Disclose**, **Daniel Ira Rosenthal MD**: Nothing to Disclose

**CONCLUSION**

Through exhaustive predictor analysis we discovered an efficient and accurate PWT predictor formula, much more accurate than constant PWT estimate. It was used to implement waiting area displays, informing patients of their anticipated wait time. This also helped us identify the outliers - patients waiting significantly longer than predicted - and train our staff to assist these patients with their needs. As a result, our PWT provided us with an improved radiology workflow, more informed patients, and staff able to concentrate on more urgent questions.

**Background**

“How long will it take?” is the most frequent question asked in the waiting rooms. Knowing Patient Wait Time (PWT) allows one to improve patient/staff satisfaction, load-balance departmental resources, develop long-term planning and strategies. Our project addressed the most fundamental question of accurate PWT prediction.

**Evaluation**

To perform PWT analysis, we used our onsite X-Ray imaging facility with 9 X-Ray units, providing images for orthopedic outpatients. 8478 exams records, corresponding to 13 consecutive weeks of patient visits and 6452 patients, were captured from the RIS database. We defined 23 independent PWT predictor variables, including patient wait line size \( L_t \), number of patients in exam rooms \( F_t \), patient arrival/processing rates, patient exam type, patient age, etc. Our goal was to build the most accurate PWT predictor, using as few parameters as possible. Therefore we analyzed all possible linear and quadratic regression predictors with up to 4 parameters selected from the original 23-parameter set.

**Discussion**

We discovered that the most accurate PWT predictor has the following form: \( \text{PWT} = W_0 + k_1 L_t + k_2 t + K_2 t^2 t \). Where: \( W_0, k_1, k_2, K_2 \) are optimally-chosen coefficients \( L_t \) is the patient waiting line size \( t \) minutes ago \( t \) is the sampling rate. The optimal sampling rate \( t \) was found to be 5 minutes. As a result, our PWT formula used the same parameter \( L_t \) sampled at 5-minute intervals. The value of \( L_t \) was found from RIS as the count of patients, who arrived but have not started their exams yet. The median error for this PWT predictor was only 3 minutes; using all 23 predictors would decrease the error only by a few seconds.

**Mine Your Data! - Enhancing Pretest Probability of Imaging through Incorporation of Data Mining Tools in Clinical Workflow**

**Supriya Gupta MBBS**: Nothing to Disclose, **Norman B. Thomson MD (Presenter): Stockholder, Nuance**
Implementation of various informatics tools can potentiate efficient clinical workflow and aid radiologists and referring physicians to synchronize their expectations from an imaging exam. Evaluation and knowledge of pretest probability can be used as a marker for assessing imaging exam utilization.

**Background**

Changing expectations of referring physicians and increasing pay for performance burden for the radiologists creates need for integrating time-saving efficient data mining tools in clinical workflow. Our purpose is to discuss the potential of integrating data mining tool at various steps in radiology workflow to enhance pretest probability of imaging exam.

**Evaluation**

We enumerate potential of data mining at each step of the clinical workflow to enhance pretest probability: Before placing exam order: Tools for auto-populating relevant patient information like allergies, pregnancy, known chronic disease, family history and contraindications for performing imaging exams. During placement of an exam order: Order entry system at any hospital leverages the most important connection in the workflow. Accurate clinical description (signs, symptoms, physical findings, pertinent lab data) should be well laid out. After order is placed: Data mining tools can be integrated into the viewer to display pertinent patient information during dictation to provide differential diagnosis by querying institutional database based on patient age, gender, location, clinical sign and type of imaging exam.

**Discussion**

Various informatics tools are currently deployed sporadically or in conjunction at various institutions for potentiating clinical and imaging workflow. However, the expectation of a referring physician may not be entirely reflected in this cumulative clinical information. Since radiologists depend on provided history and clinical examination of the referring physician. The implementation of data mining necessitates availability of an integrated EHR which is queriable. Recent push by government for adoption of EHRs should go hand in hand with data mining systems.

**SSJ13-04**

**Department Data Depot: Merging Databases for Composite Wait Time Performance Metrics**

Christine M. Zwart PhD (Presenter): Nothing to Disclose, Kun Wang MS: Nothing to Disclose, Ellen Ermer MS: Nothing to Disclose, Amy Kyio Hara MD: Nothing to Disclose, Clinton V. Wellnitz MD: Nothing to Disclose, J. Ross Mitchell PhD: Co-founder, Calgary Scientific, Inc Intellectual property, Calgary Scientific, Inc Shareholder, Calgary Scientific, Inc

**CONCLUSION**

By having a singular repository from which we could pull alternative timestamps, we were able to select the most appropriate indicator for exam start time. This type of unified framework for department databases allows easier analysis and comparison of radiology exam workflow.

**Background**

Most radiology departments make use of multiple databases for storing exam information: a PACS for images; a RIS for reports; and an EMR for patient data. These systems are complex, often from different vendors, and may not work well together. This makes measurement of critical performance metrics difficult. Furthermore, it is challenging to identify the best source for data when there is overlap. To address this we developed a Department Data Depot (DDD) - a system that pulls data from department systems then uses cross-database relationships to integrate and validate the data into a single Microsoft SQL Server database. We used FileMaker (FileMaker, Inc, Santa Clara, California) to abstract the DDD, allow simple report generation and delivery to web and mobile clients.

**Evaluation**

The pre-scan time interval is an important metric of department efficiency. It includes the time between patient check-in, appointment, and scan start. We used our EMR for appointment and check-in times. We explored three options for scan-start time: 1) The technologist recorded scan time (previous reporting standard), 2.) The time at which the exam 'arrived' in PACS, and 3.) The time recorded in the DICOM header of the first image. Each scan-start options was retrieved from a different database. Respectively: 1.) RIS, 2.) PACSHealth PACS monitoring (PACSHealth, LLC, Scottsdale, AZ), and 3.) Custom DICOM header parsing software (designed for dose monitoring).

**Discussion**

The least accurate indicator of start time was the RIS as the recorded scan time marked either the beginning or end of the scan. The most accurate indicator was the DICOM header. For CT, study arrival into PACS was similar to the DICOM indicated start time (due to the initial scout scan). Study arrival, however, was not a good start time indicator for MR where the collection and processing time may delay the first scan's arrival significantly.

**SSJ13-05**

**What Studies Did You Interpret Last Year? – Creation of Capricorn Platform for Monitoring Study Volume and Assessment of Residents’ Experience**

Yin Jie Chen MD (Presenter): Nothing to Disclose, Po-Hao Chen MD, MBA: Nothing to Disclose, Mary Helene Scanlon MD, FACR: Nothing to Disclose, Tessa S. Cook MD, PhD: Nothing to Disclose
CONCLUSION

Capricorn has been created for residents by residents to provide a tool for visualizing their portfolio of interpreted radiologic studies, an important aspect of residency experience, which is a need currently unfulfilled by existing analytic tools.

Background

Business analytics is an increasingly important element of radiology practice. However, nearly all available tools focus on enterprise-level intelligence; no analytic tools are dedicated to residency training. In radiology resident education, the volume and variety of radiologic studies comprise a critical dimension of learning. We created a resident-centered analytics tool to provide our fellow residents a user-friendly means of analyzing their portfolio of interpreted radiologic studies.

Evaluation

We created an open-source web-based platform called "Capricorn" containing a resident-centric database, in which studies are organized by modality and clinical rotation and visually organized for residents. Secure accounts ensure that a resident can access her personalized volume profile. Prior to implementation, our residents were surveyed for their views towards volume of studies interpreted plus related topics and their opinions on the Capricorn user interface. The response rate for this initial survey is 56% (27/48). In this survey, 88.9% responded that interpretation volume is "very important" or "somewhat important" to their education, and 70.4% responded that it is currently "very inconvenient" or "somewhat inconvenient" to track number of studies interpreted. We then provided the respondents a sample interface of Capricorn, after which 65% to 70% responded 4 or 5 (5 = highest) when rating Capricorn for convenience, usefulness, and functionality.

Discussion

Capricorn provides a birds-eye, comparative view of a resident's volume of interpreted studies, which are currently inconvenient to monitor over time. It should also provide a secure environment to allow residents to benchmark their own performance against historical data or track progress towards volume-related ABR requirements such as mammography. To assess their views over time, additional surveys will be administered in one and six months after the implementation of Capricorn.

Determining Imaging Characteristics of KRAS Oncogene Mutations in Colon Cancer Using Word Frequency and Naive Bayes Analysis of Radiology Reports

Siddharth Govindan MD (Presenter): Nothing to Disclose, Quanzheng Li PhD: Nothing to Disclose, Suvranu Ganguli MD: Research Grant, Merit Medical Systems, Inc Consultant, Boston Scientific Corporation, Thomas Gregory Walker MD: Nothing to Disclose, Rahmi Oklu MD, PhD: Nothing to Disclose

PURPOSE

To apply word frequency analysis and a naive Bayes classifier on radiology reports to extract distinguishing imaging descriptors of wild-type colon cancer patients and those with KRAS mutations.

METHOD AND MATERIALS

In this IRB approved study, we compiled a SNaPshot mutation analysis dataset from 457 colon adenocarcinoma patients between March, 2009 to December, 2012. From this cohort of patients, we analyzed the radiology reports of 299 patients (>32,000 reports) who were either the wild type (147 patients) or had a KRAS (152 patients) mutation. We wrote a computer program to determine the frequency of words within the wild type and mutant group radiology reports and using a naive Bayes classifier determined the probability of a given word belonging within either group.

RESULTS

Words with a greater than 50% chance (range 56-58%) of being in the KRAS mutation group and which had the highest absolute probability difference compared to the wild type group included: “several”, “innumerable”, “confluent”, and “numerous.” In contrast, words with a greater than 50% chance (range 58-61%) of being in the wild type group and with the highest absolute probability difference included: “few”, “discrete”, and “[no] recurrent.”

CONCLUSION

Words used in radiology reports, which have direct implications on disease course, tumor burden and therapy, show up with differing frequency in patients with KRAS mutations versus wild-type colon adenocarcinoma. More importantly, the study suggest that there are likely characteristic imaging traits of mutant tumors.

CLINICAL RELEVANCE/APPLICATION

Probabilistic word analysis may be useful in identifying unique characteristics and disease course associated with mutated oncogenes. This type of analysis may be applied to radiology reports as well as other types of clinical notes.

Molecular Imaging (GI/Liver)

SSJ14

Scientific Papers

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

SSJ13-06
**Sub-Events**

**SSJ14-01**

**Angiotensin Receptor Blockade Causes Measurable Increases in Drug Delivery in Pancreatic Cancer Model as Measured by 18F-5fluorouracil and PET**

Alexander Ramos Guimaraes MD, PhD (Presenter): Speakers Bureau, Siemens AG Expert Witness, Rice, Dolan, Kershaw, Vidhya Kumar: Nothing to Disclose, Rakesh K. Jain PhD: Board of Directors, XTuit Pharmaceuticals Stockholder, XTuit Pharmaceuticals, Ciprian Catana MD, PhD: Nothing to Disclose, Hong Ren PhD: Nothing to Disclose, Yves Boucher PhD: Nothing to Disclose, Jacob M. Hooker PhD: Nothing to Disclose, Andrew Hoover PhD: Nothing to Disclose, Diego Santos Ferreira PhD: Nothing to Disclose

**PURPOSE**

Pancreatic ductal adenocarcinoma (PDAC) responds poorly to chemotherapy partly due to a collagen rich desmoplastic response that is a barrier to drug delivery. Recent studies, however, have demonstrated increased survival with FOLFIRINOX, a component of which is 5-fluorouracil. In addition, angiotensin receptor blockade (ARB) with Losartan has been shown to enhance the intratumoral penetration and efficacy of therapeutics in mice using in vitro techniques. The purpose of this study was to test the hypothesis that ARB leads to measurable increased drug delivery as evidenced by labeled 18F-5fluorouracil (5FU) using microPET in a 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 Ptf-Cre/LSL-KrasG12D/p53lox mouse model) into the pancreas of 6-8 week old FVB mice. Tumors were allowed to grow to 1 week prior to treatment. Animals were treated daily with an ip injection of 70mg/kg Losartan for 5 days. 18F-5FU was synthesized using novel, recently published approaches that produce increased yield. MicroPET studies were performed on a Triumph PET/CT Scanner. Orthotopic pancreatic tumor model mice were anesthetized using isoflurane and imaged in Treated-Control pairs. Dynamic PET images were acquired for 60 minutes, using a 18F-5FU tracer dose of 200 uCi per animal. CT scans for attenuation and anatomic coregistration were performed immediately following PET acquisition. ROI analysis was performed on dynamic co-registered images using Osirix with tumor time activity curves normalized to muscle. Statistical analyses compared both cohorts using a paired two tailed t-test.

**RESULTS**

N=6 animals (3 pairs) were studied. Losartan treated animals demonstrated a mean % increase of 148% in drug delivery as measured by 18F-5FU PET that was statistically significant (p

**CONCLUSION**

ARB in a PDAC orthotopic model demonstrates reproducible, increased drug delivery using PET and labeled 18F-5FU. This method is easily translatable to humans suffering from PDAC.

**CLINICAL RELEVANCE/APPLICATION**

With the improved survival in patients with pancreatic cancer following FOLFIRINOX, this technique could be translated to study novel targeted modulation of the tumor microenvironment concomitant with 5FU based therapies.

**SSJ14-02**

**Estimation of Liver Function on Gd-EOB-DTPA-Enhanced Magnetic Resonance Imaging: Compare with T1 Mapping and the Quantitative Liver–Muscle Contrast Ratio**

Zhenpeng Peng (Presenter): Nothing to Disclose, Shiting Feng MD: Nothing to Disclose, Ziping Li MD, PhD: Nothing to Disclose

**PURPOSE**

To estimate the ability of T1 mapping of liver and the quantitative liver-muscle contrast ratio (Q-LMC) on gadolinium ethoxybenzyl diethylenetriamine pentaacetic acid (Gd-EOB-DTPA)-enhanced magnetic resonance imaging for the estimation of liver function.

**METHOD AND MATERIALS**

Institutional Review Board approval and written informed consent were obtained. 94 patients underwent MRI with a 3.0T system before and at 20 minutes after Gd-EOB-DTPA administration. 73 were Child-Pugh class A(CPA), 14 were B(CPB) and 7 were C(CPC). T1 maps were acquired using three dimensional spoiled gradient echo sequences with two different flip angles (2 and 11 ) and a fixed TR/TE (4.4ms/1.2ms). Liver T1 values were obtained using a T1 processing tool (MapIT software). T1 relaxation time of liver and reduction rate of T1 relaxation time between pre- and post-contrast enhancement were measured. The quantitative liver-muscle contrast ratio (Q-LMC) was calculated using the signal intensities of the liver and erector spinae with fat-suppressed FLASH T1-weighted sequence images. The one-way anova and pearson correlation were used for comparisons between the 2 methods.

**RESULTS**

Post-contrast T1 relaxation times of liver were significantly reduced. The reduction rate of T1 relaxation time in CPA/CPB/CPC were 77.6±8.4%, 62.6±8.5%, 50.7±12.5%. The difference between each group were significant (P<0.05). The increase Q-LMC in CPA/CPB/CPC were 59.4±8.5%, 48.5±6.3%, 46.2±6.2%. The difference
between CPA/CPB and CPA/CPC were significant (P<0.05), but the difference between CPB/CPC was not significant (P>0.05). The Pearson correlation coefficient of the reduction rate of T1 relaxation time and the Q-LMC were -0.648 and -0.526.

CONCLUSION

Both the T1 mapping of liver and the Q-LMC before and after Gd-EOB-DTPA administration can help estimate liver function. The reduction rate of T1 relaxation time was the better index of liver function than the Q-LMC.

CLINICAL RELEVANCE/APPLICATION

The reduction rate of T1 relaxation time was the better index of liver function than the Q-LMC.

SSJ14-03

Assessment of Aquaporins Function of Early-stage Liver Fibrosis Using Multi-B Diffusion-weighted MRI

Qiu-Ju LI MD (Presenter): Nothing to Disclose, Jiahui Li MD: Nothing to Disclose, Bing Yu MD: Nothing to Disclose, Yu Shi PhD: Nothing to Disclose, Zhou She Zhao: Nothing to Disclose, Zi-Heng Zhang: Nothing to Disclose, Qiyong Guo MD: Nothing to Disclose

PURPOSE

To investigate the relationship between the ADC values and AQP expression, using a multiple b-value (multi-b) diffusion-weighted magnetic resonance imaging (DW MRI), with the histopathological and immunohistochemical tests as gold standard.

METHOD AND MATERIALS

24 rodent liver fibrosis models at different fibrotic stages were prepared in male Wistar rat for the experiment through thioacetamide injection thrice a week with another 6 intact as the control group. Both groups were performed MR measurements on a 3. T scanner, before and after the injection of acetazolamide solution, an typical AQP inhibitor, used to inhibit the AQP1, AQP3 and AQP4 on hepatic tissue. For the MR protocol, besides the conventional T1WI and T2WI, a multi-b DWI was carried out with 18 b values selected from 0 to 4500 s/mm2 (low-b: <200 s/mm2, mid-b: 300-1500s/mm2 and high-b: 1700-4500 s/mm2). The obtained multi-b DW images were post-processed through a newly developed tri-exponential model with low-b, mid-b, and high-b ADCs achieved. The output parametric maps were reviewed and analyzed blindly by two experienced observers with no histologic detail informed. The same layer of the harvested lobe were chosen for the routine HE staining, Sirius red staining of collagen, and AQP1 molecular pathology staining to determine the stage of liver fibrosis and the AQP1 expression level. Liver fibrosis was evaluated according to the Metavir scoring system.

RESULTS

The AQP1 expression in the liver endothelial cells significantly increased with aggravation of liver fibrosis from normal to early stage fibrosis. The mean high-b ADC value of S2 was significantly higher than S1, both higher than S0 (P<0.05), which was in accordance with the result of immunohistochemical tests. At S1, the high-b value post inhibitors injection had a significant decrease (>30%), and 20% higher than S2. However, the inhibition tests were negative at S0.

CONCLUSION

It was demonstrated in this study that the severity of liver fibrosis is positively correlated with the AQP1 expression and the multi-b DW MRI technique was capable to detect the S1 stage liver fibrosis.

CLINICAL RELEVANCE/APPLICATION

AQP multi-b DWI molecular imaging is a promising tool for early diagnosis of liver fibrosis.

SSJ14-04

Prognostic Value of Simplified Dual-timepoint FDG-PET/CT in Pancreatic Cancer: Comparison to Routine SUV Measurements

Freimut Juengling MD, PhD (Presenter): Nothing to Disclose, Christian Bieg MD: Nothing to Disclose, Ralph Peterli MD: Nothing to Disclose, Ines Valenta: Nothing to Disclose, Markus Von Flue MD: Nothing to Disclose, Markus Gass MD: Nothing to Disclose

PURPOSE

To evaluate the prognostic value of early dual-timepoint kinetics in pancreatic malignancies as compared to routine single SUV measurements alone.

METHOD AND MATERIALS

In a prospective analysis of 55 consecutive patients with histological or cytological diagnosis of pancreatic cancer, scheduled for FDG-PET/CT, dual-timepoint PET/CT was performed at 60 min. and 90 min. after application of FDG. Images were fused with routine MRI and accordingly, lesional SUV min, SUVavg and SUVmax were respectively measured for each timepoint. Regional changes in SUVs were calculated as previously described. Patients were followed-up for 12-70 months, with death or survival as primary endpoint. For analysis of prognostic significance on survival, patients were assigned to two pairs of groups, according to...
regional changes in SUV exceeding a cut-off of 3.5 in SUVmax or of 11% change in SUV measurements and Kaplan-Meier survival curves were plotted using MedCalc software. Survival curves were compared using the logrank test.

**RESULTS**

Comparison of survival rates between groups based on SUVmax >= 3.5 vs. SUVmax < 3.5 (a cutoff proposed by several groups, eg. Hu et al. 2013) did not result in a significant difference between groups (logrank test, P=0.9298), while a regional SUV increase of more than 11% differentiated between a high-mortality group (36% survival probability at 24 months; 22% at 36 months) and a low-mortality group (86% survival probability at 24 months; 68% at 36 months, P=0.0041, logrank test)

**CONCLUSION**

Dual timepoint FDG-PET/CT performed as early as 30 minutes after the initial study adds significant prognostic information to standard PET evaluation based on single SUV measurements and differentiates between a high-mortality group and a low-mortality group at 24 and 36 months after initial diagnosis.

**CLINICAL RELEVANCE/APPLICATION**

The proposed dual-timepoint PET/CT imaging protocol adds significant, prognostic information on survival probability, as compared to standard imaging and SUV measurements. The additional time and effort, consisting in 5 minutes of additional scanning immediately after completion of routine protocols, is minimal and fits perfectly into the existing, clinical workflow.

**SSJ14-05**

**Transcriptomic and Immunohistochemical Profiling of Pancreatic Ductal Adenocarcinoma: Search for Functional Imaging Biomarkers**

**PURPOSE**

Imaging plays an important role in the management of patients with pancreatic ductal adenocarcinoma (PDAC); however, the ability to reliably detect early stage tumors and accurately identify the true extent of disease preoperatively is severely limited with current anatomical diagnostic imaging techniques (computed tomography, magnetic resonance imaging, endoscopic ultrasound). We employed a target-centric strategy to identify transporter proteins upregulated in PDAC versus normal pancreas as potential targets for a new functional imaging probe to complement existing anatomical imaging approaches.

**METHOD AND MATERIALS**

We have performed transcriptomic (gene expression) profiling using laser capture microdissection, microarray and RNAseq on histologically-confirmed primary PDAC tumors and normal pancreas tissue from 33 patients, including five patients whose tumors were isoattenuating to normal pancreas and not visible on CT. RNAseq data were analyzed as gene normalized counts using the mapped reads per kilobase per million mapped reads (RPKM) method. Target expression at the protein level was confirmed with immunohistochemistry on tissue microarrays from 94 PDAC patients. All studies on human specimens were approved by our Institutional Review Board.

**RESULTS**

Our search has identified at least 10 candidate transporter proteins upregulated in PDAC versus normal pancreas. Thus far, the best potential imaging target identified was SLC6A14, a neutral and basic amino acid transporter. SLC6A14 was overexpressed at the transcriptional level in all patients and expressed at the protein level in 95% of PDAC tumors.

**CONCLUSION**

SLC6A14 merits further investigation as a candidate transporter for functional imaging of PDAC.

**CLINICAL RELEVANCE/APPLICATION**

A new functional imaging probe that selectively targets PDAC with high sensitivity could transform patient management by allowing earlier detection and surgical intervention, and improving preoperative staging of disease.

**SSJ14-06**

**Pre-treatment FDG-PET/CT Predicts Distant Relapse Following Percutaneous Ablation for Colorectal Liver Metastases**

**Percutaneous Ablation**

**Transcriptomic and Immunohistochemical Profiling of Pancreatic Ductal Adenocarcinoma: Search for Functional Imaging Biomarkers**

**PURPOSE**

Imaging plays an important role in the management of patients with pancreatic ductal adenocarcinoma (PDAC); however, the ability to reliably detect early stage tumors and accurately identify the true extent of disease preoperatively is severely limited with current anatomical diagnostic imaging techniques (computed tomography, magnetic resonance imaging, endoscopic ultrasound). We employed a target-centric strategy to identify transporter proteins upregulated in PDAC versus normal pancreas as potential targets for a new functional imaging probe to complement existing anatomical imaging approaches.

**METHOD AND MATERIALS**

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**CONCLUSION**

SLC6A14 merits further investigation as a candidate transporter for functional imaging of PDAC.

**CLINICAL RELEVANCE/APPLICATION**

A new functional imaging probe that selectively targets PDAC with high sensitivity could transform patient management by allowing earlier detection and surgical intervention, and improving preoperative staging of disease.
PURPOSE

Percutaneous ablation has a role in the local treatment of colorectal liver metastases. Patients are typically selected for therapy based on technical, rather than biological, considerations. Pre-treatment techniques to allow improved patient selection for local therapy would be of clinical value. The aim of this study was to assess whether quantitative [18F]-FDG-PET/CT (PET/CT) was associated with patterns of disease relapse at 1 year.

METHOD AND MATERIALS

This was a retrospective cohort study of 24 patients with solitary colorectal liver metastases, who underwent percutaneous ablation. All patients had a PET/CT scan prior to treatment. The presence of intra- or extrahepatic distant metastatic relapse at 1 year was determined by contrast-enhanced CT, and MRI or PET/CT where available. Patients with metastatic relapse were classified into oligometastatic or polymetastatic patterns of relapse; oligometastatic disease was defined as limited relapse (≤3 metastases), which remained amenable to local treatment. The PET/CT parameters SUVmax, SUVpeak, metabolic tumour volume (MTV) and tumour glycolytic volume (TGV) were derived using commercially available software (Hermes Medical Solutions, AB, Stockholm). The association of these parameters with patterns of subsequent metastatic relapse was tested using standard statistical techniques.

RESULTS

The 24 patients were categorized as follows: 9 polymetastatic relapse, 4 oligometastatic relapse, 11 no relapse. All patients with an SUVmax > 13 had polymetastatic relapse within one year. There was a significant difference of SUVmax (7.47 vs 14.15, p=0.002) and TGV (79.5 vs 664.0, p=0.016) between those with polymetastatic relapse compared with oligometastatic or no relapse. The AUC for the ROC curve for SUVmax to predict polymetastatic compared with oligometastatic or no relapse at 12 months was 0.875 (Figure 1).

CONCLUSION

Baseline PET/CT can provide prognostic information for patients undergoing percutaneous ablation for solitary colorectal liver metastases, which may allow improved patient selection for local therapy. This may be because FDG-uptake reflects underlying differences in tumour biology.

CLINICAL RELEVANCE/APPLICATION

Selection for percutaneous ablation of colorectal liver metastases is based largely on technical, rather than biological, considerations. PET/CT can provide prognostic information, which may allow improved patient selection for local therapy.

SSJ15
ISP: Musculoskeletal (Hip and Pelvis Evaluation)

PURPOSE

To investigate the accuracy of non-arthrographic 3T MRI compared to hip arthroscopy, in assessment of labral and cartilaginous pathology in patients with suspected FAI.

METHOD AND MATERIALS

Following IRB approval and waived consent, 42 consecutive cases of suspected FAI with non-arthrographic 3T MRI and arthroscopy of the hip were reviewed. High-resolution TSE MR imaging including radial acquisitions were evaluated in consensus by 2 musculoskeletal radiologists, blinded to arthroscopic findings, for the presence of labral tears and articular cartilage lesions. Acetabular cartilage was categorized as normal, degeneration/fissuring, delamination, or denudation. MRI findings were compared to arthroscopy. Sensitivity, specificity, accuracy, and predictive values for MRI were calculated using arthroscopy as the standard of
RESULTS

42 hips in 38 patients with a mean age of 29 (range 13-45 years) were assessed. Mean interval between MRI and arthroscopy was 154 days (range 27-472 days). MRI depicted 41 cases with labral tears (sensitivity 100%, specificity 50%, accuracy 98%, PPV 98%, NPV 100%), 11 cases with femoral cartilage abnormalities (sensitivity 85%, specificity 100%, accuracy 95%, PPV 100%, NPV 94%), and 36 cases with acetabular cartilage lesions (sensitivity 94% specificity 67%, accuracy 90%, PPV 94%, NPV 67%). Of the 36 cases with acetabular cartilage lesions on MRI, 7 were characterized as degeneration/fissuring, 26 as delamination, and 3 as denudation, with discordant results between MRI and arthroscopy for grading of articular cartilage in 10 cases.

CONCLUSION

Non-arthrographic 3T MR imaging is a highly accurate technique for evaluation of the labrum and cartilage in patients with clinically suspected FAI.

Diagnostic Performance of MR Arthrography of the Hip under Axial Leg Traction in the Detection and Grading of Labrum Lesions in FAI Patients: Preliminary Results

Florian Schmaranzer (Presenter): Nothing to Disclose, Michael Kogler MD: Nothing to Disclose, Markus Reichkendler: Nothing to Disclose, Ehrenfried Schmaranzer: Nothing to Disclose

PURPOSE

Though direct MR arthrography (MRA) improved assessment of labral defects, tight anatomy of the hip restricts the visualization of labrum lesions in some cases. Therefore application of traction during MR imaging has been proposed to overcome femoroacetabular coaptation. It was aimed to assess the diagnostic performance of MRA of the hip under axial leg traction in the detection and grading of labrum lesions in patients with femoroacetabular impingement (FAI) and arthroscopy as reference.

METHOD AND MATERIALS

Method and Materials: Over a period of 5 months, 53 symptomatic patients underwent preoperative MRA of the hip according to the institutional routine protocol on a 1.5 T unit and hip arthroscopy at our institution. The protocol included: coronal, sagittal, axial planes with traction and a coronal plane without traction and an intraarticular injected volume of up to 27 ml. A dedicated traction device was used with weight load ranging from 15-23 kg according to patients constitution. After exclusion of 15 hips (1 LCE < 25°, 4 Tennis 3, 3 previous surgery, 7 delay >6 months), 38 hips/patients (mean age; 34a, 14 cam-, 4 pincer-, 20 mixed-type FAI) remained in the study cohort. On coronal MR arthrograms obtained ± traction it was evaluated whether the chondro-labral interface could be differentiated. Lesions were graded as labral-chondral separations, partial/complete tears, flap tears and complex tears. Sensitivity, specificity and agreement within one grade of traction MRA in detection of labrum lesions was calculated with arthroscopy as reference.

RESULTS

With, without traction the chondro-labral interface could be differentiated in 37 (P =97%) respectively 10 hips (P =26%). 1/2 (P = 50%) intact labra, 2/5 (P = 40%) labral-chondral separations, 16/18 (P = 89%) partial tears, 2/2 (P = 100%) complete tears, 2/2 (P = 100%) flap tears and 9/9 (P = 100%) complex tears were correctly identified. Sensitivity, specificity, agreement within one grade was 97%, 50%, 84% respectively.

CONCLUSION

Traction MRA enabled delineation of the chondro-labral interface and was highly accurate in detection and grading of labrum lesions. Future trials should assess a potential benefit of traction MRA over conventional MRA.

CLINICAL RELEVANCE/APPLICATION

The labrum ensures the dynamic stability of the hip joint. Traction MRA showed encouraging results in detection and grading of these lesions which should facilitate targeted therapy planning.

Radiographic Correlates of Arthroscopically Proven Partial Tears of the Ligamentum Teres in Patients with Femoroacetabular Impingement

Gavin Blair Gore MD (Presenter): Nothing to Disclose, Scott David Wuertz MD, MS: Nothing to Disclose, Laura Raffield BS: Nothing to Disclose, Elizabeth A. Howse: Nothing to Disclose, Aliston J. Stubbs: Nothing to Disclose, Leon Lenchik MD: Nothing to Disclose

PURPOSE

In patients with femoroacetabular impingement (FAI), partial tears of the ligamentum teres are common and may contribute to the hip joint microinstability. The purpose of this study was to determine if the radiographic findings of acetabular over-coverage or early osteoarthritis are associated with arthroscopically proven partial tears of the ligamentum teres (LT).

METHOD AND MATERIALS
243 patients undergoing hip arthroscopy for FAI had radiographic evaluation with supine anteroposterior views of the pelvis as well as frog-lateral, cross-table lateral, and false-profile views of the symptomatic hips. Measurements of the lateral center-edge, anterior center-edge, and Sharp's angles were performed. Evaluation of acetabular overcoverage using the cross over sign, the posterior wall sign, coxa profunda, and acetabular protrusio was performed. Evaluation of osteoarthritis using the Tonnis grade, hammock sign (posteromedial sclerosis), saber-tooth sign (cotyloid osteophyte), and sea-gull sign (remodeling of superolateral acetabulum) was performed. Univariate and age-adjusted analyses were used to evaluate the association between radiographic findings and LT tears.

RESULTS

74 men and 169 women, ranging in age from 12 to 68 with a mean age of 34 years, were included in the study. 163 had partial LT tears and 80 had normal LTs. Partial LT tears were significantly more common in younger patients (p=0.008). In the partial tear group, mean lateral center-edge was 30, anterior center-edge was 32, and Sharp's angle was 41. In the normal group, mean lateral center-edge was 32, anterior center-edge was 33, and Sharp's angle was 39. In women with partial tears, there was a trend toward a decreased lateral center-edge angle (p=0.053) and a trend toward a decreased anterior center-edge (p=0.057). After age-adjustment in women, there was also a trend toward decreased profunda (p=0.064). The remaining radiographic signs showed no significant association with partial LT tears.

CONCLUSION

There is no significant association between radiographic findings of acetabular over-coverage or early osteoarthritis and arthroscopically proven partial tears of the ligamentum teres.

CLINICAL RELEVANCE/APPLICATION

Although ligamentum teres are common and contribute to hip pain, little is known about what radiographic or clinical findings predispose patients to them.

SSJ15-04

Normal Values of the Subspinal Interval and the Angle of AIIS - Acetabulum: A Multicentric CT Study


PURPOSE

The purpose of this study was to define the normal values of subspine interval (SI), and the angle of anterior inferior iliac spine (AIIS) - acetabulum (AAA) in normal individuals.

METHOD AND MATERIALS

We reviewed abdomen computed tomography scans of 157 patients who had been examined for reasons other than subspine impingement. For the measurements, sagittal-oblique reformatted images that parallel to midaxis line of AIIS were obtained. The SI was accepted as the distance between the most anterior-inferior edge of the AIIS and the acetabular rim. The AAA was defined as the angle between the line traversing through the long axis of AIIS and the line that connecting the points of conjunction of acetabular roof and deepest medial cortex of AIIS in the axial images. Normal values and ranges of both SI and AAA were assessed. Age and gender differences were analyzed.

RESULTS

312 measurements of SI were made in 157 patients. 77 female(49%) and 80 male(51%) patients were included by the study. Mean age was 34.44 years with a range of 20-50 years. Overall, mean SI was found as 15.77±3.73 mm. SI was found to be significantly lower in females than that of males (17.22±3.34 mm in males, 13.61±2.85 mm in females, P=0.02). The mean AAA was calculated as 110.8°(with a range of 90°-129°). Patients with severe degeneration and developmental dysplasia of hip joint were not included by the study.

CONCLUSION

Subspine impingement is a recently described subtype of femoro-acetabular impingement. Its clinical diagnosis might be challenging and there are no objective radiological measurements to adequately describe this pathology. To the best of our knowledge, normal values of SI in asymptomatic individuals have not been reported in the English language literature. The range of normal values of SI might be helpful in the diagnosis of subspine impingement. Moreover, smaller values of AAA might indicate narrowing of the potential subspine space, causing pathological contact of the AIIS and femoral head during hip flexion. Further clinical studies are needed to investigate the relevance of our radiological findings.

CLINICAL RELEVANCE/APPLICATION

Subspine impingement has been reported to be a potential cause of femoroacetabular impingement. CT measurement of the subspine interval and the curve of AIIS may be helpful in diagnosis. Definition of normal values will form the base of further studies to describe pathological cut-off values.

SSJ15-05

Pubic Bone Stress Oedema as a Predictor of Return to Play in Athletes with Groin Pain
PURPOSE
To correlate MRI imaging findings of Pubic Bone Stress Oedema (PBOS) with clinical examination standardized clinical performance models and return to play in a cohort of 300 patients presenting with exercise induced groin pain.

METHOD AND MATERIALS
MRI scans from 300 consecutive patients attending a dedicated groin injury clinic in a large specialist Sports Medicine and Orthopedic hospital were reviewed. A standard 3 tesla MRI groin imaging protocol was performed on all patients. Findings of pubic bone stress oedema were graded and then compared to standardized clinical assessment scores (Copenhagen Hip and Groin Outcome Score, HAGOS) and to time to return to play in all patients. Minimum patient follow up for study inclusion was 12 months.

RESULTS
Volume of pubic bone stress oedema (PBOS) correlated well with patient return to play times. There was poor correlation of volume and location of PBOS with HAGOS standardized clinical assessment scores. Laterality of PBOS (right versus left) did not correlate well with findings on clinical exam. There was no association between secondary cleft sign, common anterior plate rectus abdominus and adductor longus insertional tenonopathy or pubic symphysis joint effusion and return to play.

CONCLUSION
Volume of Pubic Bone Stress Oedema on MRI can be used to accurately predict return to play times in athletic patients presenting with groin pain.

CLINICAL RELEVANCE/APPLICATION
Groin pain is a common complaint amongst both recreational and elite athletes. Accurate diagnosis and treatment as well as prediction of return to play can be difficult. MRI findings of Pubic Bone Stress Oedema can be used as a useful predictor of return to play in this cohort.

SS15-06
Longitudinal MRI Follow-up of Patients with Large Head Metal on Metal Total Hip Arthroplasties
Nicola Jane Lyle MBBS (Presenter): Nothing to Disclose, Toby Briant-Evans: Institutional Research Grant, Biomet, Inc, Jennifer Teresa Hauptfleisch MBChB, FRCR: Nothing to Disclose, Andrea Pearce: Nothing to Disclose, Richard Harker: Nothing to Disclose, Kevin Conn: Nothing to Disclose, John Britton: Nothing to Disclose, Geoff Stranks: Nothing to Disclose

PURPOSE
MRI is the gold standard imaging modality to assess soft tissue complications which occur around metal on metal (MoM) hip prostheses due to adverse reaction to metal debris (ARMD). The MR features of these 'pseudotumours' are well established but relatively little is known about the natural history of ARMD. This knowledge would be invaluable for appropriate patient management. The aim of this study was to investigate MRI changes over time in longitudinal follow up of our MoM total hip arthroplasties (THAs).

METHOD AND MATERIALS
155 large head MoM THAs underwent at least two separate MRI scans. The images were reviewed retrospectively by two musculoskeletal radiologists and 1 orthopedic surgeon. They were classified as 1. Normal 2. Trochanteric fluid only 3. Effusion 4. ARMD (extra-articular fluid/ solid collections) The latter group was further classified according to the Oxford classification into Type I (thin-walled cystic), Type II (thick-walled cystic) and Type III (predominantly solid). Lesion volumes were also measured.

RESULTS
The mean time from primary surgery to first scan was 48 months. The median interval between scans was 15 months. 54 (35%) were classified as normal and 30% of these hips developed an abnormality by the time of the second scan. 19 (12%) had isolated trochanteric fluid of which 9 (47%) got larger or developed into Type I ARMD lesions. 12 (8%) had effusions and 6 (58%) progressed in volume with one becoming a Type I ARMD lesion. 70 (46%) had ARMD, 49 type I, 16 type II and 5 type III. There was a significant increase in size of the pseudotumours in type I and II categories (77% progression rate). New osteolysis was seen in 4 cases in the type II group (25%). Lesions most likely to progress had an irregular pseudocapsule and progression was associated with high cobalt levels.

CONCLUSION
Little has been published on the natural history of pseudotumours. In our series there was a high rate of ARMD (46%) and the majority (77%) showed a significant increase in size on serial MR. Pseudotumours with an irregular lining were more likely to progress. This progression rate is higher than in recently published smaller longitudinal series.

CLINICAL RELEVANCE/APPLICATION
In MR follow-up of patients with MoM THAs there was a 46% rate of ARMD and 77% progressed. The decision to revise is clinical but this high rate of progression may lower the threshold for revision.
**SSJ16**

**Musculoskeletal Imaging (Clinical Imaging Metabolic Disease and Osteoporosis)**

**Scientific Papers**

**SSJ16-01**

**Marrow Fat Composition in Anorexia Nervosa**

Miriam Antoinette Bredella MD (Presenter): Nothing to Disclose, Pouneh Fazeli: Nothing to Disclose, Scott M. Daley: Nothing to Disclose, Karen K. Miller MD: Nothing to Disclose, Clifford J. Rosen: Nothing to Disclose, Anne Klubanski MD: Nothing to Disclose, Martin Torriani MD: Nothing to Disclose

**PURPOSE**

Women with anorexia nervosa (AN) have increased marrow fat despite severe depletion of body fat. Recent studies have suggested that marrow fat composition may serve as a biomarker for bone quality. The purpose of our study was to investigate 1) marrow fat composition of the femur using proton MR spectroscopy (1H-MRS), and 2) the relationship between measures of marrow fat composition and BMD and body composition in women with AN and normal-weight controls.

**METHOD AND MATERIALS**

The study was IRB approved and complied with HIPAA guidelines. Written informed consent was obtained from all subjects after the nature of the procedure had been fully explained. 14 women with AN (29.5±1.9 years) and 12 normal-weight controls if similar age underwent 1H-MRS at 3.0T (Siemens Trio, Siemens Medical Systems, Erlangen, Germany) using a PRESS pulse sequence of the femoral diaphysis to determine total marrow fat content and marrow fat composition and of soleus muscle to determine intramyocellular lipids und unsaturated muscle lipids. MRI was performed to quantify abdominal fat, thigh fat and muscle. Lumbar spine BMD, fat and lean mass were assessed by DXA.

**RESULTS**

Subjects with AN had higher marrow fat content (p<0.05), but similar marrow fat composition (p >0.05) compared to normal-weight controls. There was an inverse association between marrow methylene protons, an estimate of fatty acid (FA) saturated bonds, and lumbar spine BMD (r= -0.52, p=0.008) independent of %ideal body weight (%IBW) and total lipid content. Olefinic protons at 5.3 ppm, an estimate of FA unsaturated bonds, were inversely associated with body fat depots, independent of %IBW and total lipid content, and positively associated with soleus muscle unsaturation (p≤0.05).

**CONCLUSION**

Women with AN have higher total femoral marrow fat but similar composition compared to normal-weight controls. The degree of marrow FA saturation correlates inversely with BMD, suggesting that saturated lipids may have negative effects on BMD. The degree of marrow FA unsaturation correlates positively with soleus unsaturation, suggesting that marrow fat composition may be influenced by the same factors as ectopic lipid composition.

**CLINICAL RELEVANCE/APPLICATION**

Marrow fat composition assessed by 1H-MRS may serve as a biomarker for bone quality and metabolic risk.

**SSJ16-02**

**Significance of Sarcopenia in Soft-tissue Sarcoma Patients: Do Skeletal Muscle and Fat Measures of Body Composition on Routine CT Exams Help Predict Clinical Outcomes?**

Robert Downey Boutin MD (Presenter): Nothing to Disclose, Jeremy Richard Katz MD: Nothing to Disclose, Abhijit Jarawant Chaudhari PhD: Nothing to Disclose, Jonah Scott Hirschbein MD: Nothing to Disclose, Yves-Paul Nakache : Nothing to Disclose, Chin-Shang Li PhD: Nothing to Disclose, Ramit Lamba MD: Nothing to Disclose, Ghaneh Fananapazir MD: Nothing to Disclose, Robert Canter MD: Nothing to Disclose

**PURPOSE**

To assess muscle and fat metrics as prognostic indicators of outcomes in sarcoma patients.

**METHOD AND MATERIALS**
147 patients (81 M, 66F; mean age, 53 years; range, 1-85) diagnosed with a soft-tissue sarcoma between 2000 and 2013 with inclusion criteria (including availability of BMI, stage, grade, depth, abdominopelvic CT, follow-up) were retrospectively studied after IRB approval. Treatment included surgery (n=124), pre-op radiation (n=35), pre-op chemotherapy (n=13), or a combination. Using a routine CT exam, the L4 pedicle level was analyzed for 4 skeletal muscle metrics (total muscle area [TMA], average total muscle density [TMD], psoas area [PA], average psoas density [PD]) using manual segmentation by a musculoskeletal radiologist. Visceral and subcutaneous fat metrics (area, mean density, SD density) were quantitated at the same level using automated segmentation. Clinical outcome variables were evaluated, including overall survival and major post-surgical complications (within 30 days).

RESULTS

At presentation, stage distribution was as follows: stage 1 (n=51), 2 (n=27), 3 (n=55), 4 (n=14). Survival averaged 27.2 months (range, 0.2-156) from the date of diagnosis. Muscle and fat metrics varied widely among patients. TMA averaged 106 cm² (range, 7-194), with a TMD of 32 HU (range, -24 to 75). Univariable Cox PH regression analysis demonstrated that PD was a significant prognostic indicator of overall survival (HR = 0.97 (0.94, 0.99), p = 0.002) in the entire cohort, as well as when stage 4 patients were excluded (HR = 0.95 (0.93, 0.98), p = 0.001). TMD also was a significant predictor of overall survival when stage 4 patients were excluded (HR = 0.97 (0.94, 0.99), p = 0.03). TMD (OR = 0.97 (0.95, 0.99), p = 0.04), PD (OR = 0.96 (0.92, 0.99), p = 0.03), visceral fat area (OR = 1.004 (1.0, 1.008), p < 0.05), and subcutaneous fat density SD (OR = 1.16 (1.01, 1.33), p = 0.04) were significant predictors of major surgical complications in univariable logistic regression analysis for the entire cohort, but not in the multivariable model.

CONCLUSION

Routine CT can be used to quantify muscle and fat metrics; some body composition measures appear to have prognostic significance in soft-tissue sarcoma patients.

CLINICAL RELEVANCE/APPLICATION

Although muscle and fat metrics are not routinely analyzed on CT exams, both muscle and fat are routinely imaged, are easily measured, and are potential prognostic biomarkers for sarcoma patients.

SSJ16-03

Multimodality Imaging Shows Cytotoxic Cancer Therapy Causes Rapid Expansion of Marrow Fat (MF) and but Slower Decrease in BMD Causing Failure of Their Inverse Correlation Why We Should Think Differently about Cancer Survivors; Bone Health - Multi-modal


PURPOSE

Cancer survivors have an increased risk of osteoporotic fractures. However the extent of bone and marrow damage is poorly understood. The purpose is to develop multimodality imaging to monitor BandM changes quantitatively with time

METHOD AND MATERIALS

We used dual energy CT (DECT), water-fat MRI (WFMRI), quantitative CT (QCT) and DXA to measure one-year changes in MF and BMD associated with three cancer treatments: oophorectomy, radiotherapy or chemotherapy. We also measured changes in circulating adiponectin levels. Twenty nine patients with gynecologic malignancies underwent DECT and DXA at 0, 6 and 12 months post-treatment; 15 were also imaged by WF-MRI.

RESULTS

We observed a high overall correlation (r = 0.77, 95% CI: 0.69, 0.83) between DECT and WF-MRI based MF quantification at L3, L4, and L5 for 15 subjects (Figure A). Likewise, changes in MF from 0 to 12 months were highly correlated by both imaging methods (r = 0.91, 95% CI: 0.84, 0.95). MF increased significantly from 0 to 12 months (p<0.002 at L3, L4, L5, and FN). All three treatments increased MF (p<0.032), but chemotherapy and radiation caused greater increases than oophorectomy (Figure B andC). L4 BMD measured by DECT decreased most after chemotherapy (p=0.01), followed by radiation (p=0.09) and oophorectomy (p=0.24). L4 BMD decreased 14% by DECT, 20% by QCT, but only by 5% by DXA (p<0.002 for all) (Figure D). At baseline, we observed a statistically significant, inverse association between MF and BMD. By contrast, at 12 months the inverse association between MF and BMD was dramatically attenuated (Figure E andF). Adiponectin increased from 0 to 12 months without changes in total body fat.

CONCLUSION

Our study demonstrated rapid increases in MF following radiotherapy and chemotherapy. Additionally, DECT detected much greater changes in BMD than did conventional DXA. Our results suggest that contrary to the general population, MF and BMD cannot be used interchangeably to monitor skeletal health following cancer therapy. Longitudinal studies in larger population are needed to determine if increases in MF and adiponectin are associated with long-term sustained bone damage and ultimate ability to predict fracture risk.
Complications of Atypical Femoral Fractures: Does Fracture Morphology or Instrumentation Type Predict Hardware Failure?


PURPOSE

Long-term bisphosphonate use has been associated with Atypical Femoral Fractures (AFFs). The purpose of this study is to evaluate the association of fracture morphology and hardware type with hardware failure in patients with AFFs.

METHOD AND MATERIALS

Imaging studies of 100 patients with 131 AFFs (4 male, 96 female, mean age 68.1 years) with hardware instrumentation from July 2004 to February 2014 were reviewed. Type of instrumentation, fracture morphology (overall fracture morphology (OFM)), lateral cortical fracture angle (LCFA), lateral cortical thickness, femoral angle), and fracture location were compared in the hardware complication group and control group using the Wilcoxon rank sum test or Fisher's exact test.

RESULTS

131 AFFs had instrumentation (98 for complete and 33 for incomplete fractures). Instrumentation included intramedullary (IM) nailing (117), dynamic hip screw (7), lateral plate (2), short gamma nail (3), total hip arthroplasty (1), and compression plate (1). Hardware complications occurred in 15.3% (21/131) and were more common in complete (8/21) than incomplete (3/21) fractures. Complications included screw fractures in 19% (4/21), plate fractures in 14.3% (3/21), loosening of hardware in 28.6% (6/21), nonunion in 9.5% (2/21), and a combination of complications in 28.6% (6/21). Hardware failure was significantly less common after IM nailing (12.8%) compared to other hardware (35.7%) (p = 0.04). Comparing failure to non-failure group, the mean OFM was 31.9° (vs 36.3°), the mean LCFA was 7.0° (vs 11.3°), the mean lateral cortical thickness was 12.1 mm (vs 12.1 mm), the mean medial cortical thickness was 8.9 mm (vs 7.8 mm), femoral angle 133° (vs 139°). Comparing the failure to the non-failure group, the location of fracture was 14.9 cm (vs 16.8 cm) from the greater trochanter. Of all measured parameters, only the LCFA was significantly associated with hardware failure (p = 0.03).

CONCLUSION

In patients with AFFs, hardware complications are not uncommon. Hardware failure is more common in AFFs with smaller LCFA and when fixation other than IM nailing is used.

CLINICAL RELEVANCE/APPLICATION

Patients who undergo hardware fixation for AFFs are at risk for hardware failure and should be followed for development of complications. Surgeons should consider IM nailing for treatment of AFFs.

Bilateral Atypical Femoral Fractures: How Much Symmetry Is there on Imaging?


PURPOSE

If MF is the key results of cytotoxic therapy, more effective preventive therapy must be to reverse or suppress adipogenesis in addition to common method of antiresorptive therapy that is common used for general population
**Atypical Femoral Fractures (AFFs) are commonly bilateral. The purpose of this study is to evaluate bilateral AFFs and to determine if the imaging features of both fractures are similar.**

**METHOD AND MATERIALS**

Imaging studies of 76 patients with bilateral AFFs were retrospectively reviewed (3 male, 73 female, age range 31.1 to 91 years, mean age 67.3 years). The time interval between fracture diagnoses was determined. For each fracture, the following imaging features were evaluated: location of fracture, femoral angle, length of cortical thickening, comminution, medial spike (proximal or distal fragment), and fracture orientation (superior or inferior). Associations between imaging findings on pairs of bilateral fractures were assessed with Spearman’s correlation (r) and the Kappa (κ) statistic.

**RESULTS**

Bilateral fractures (62 incomplete and 14 complete) occurred within 12 months of each other in 59/76 cases (77.7%). Average time between fracture diagnoses was 10.2 months. 90% of bilateral fractures occurred within 2.9 years of each other (range 0 to 120 months). There was a strong correlation between fracture location (r=0.68) with 58/76 cases (76.3%) of bilateral fractures occurring within a distance of less than 5 cm. 41/76 cases (53.9%) had a distance of less than 2.5 cm between bilateral fractures. There was moderate correlation between femoral angles (r=0.4) and weak correlation between length of cortical thickening (r=0.28). There was substantial agreement for medial spike location (κ=0.67) and fracture orientation (κ=0.62), and moderate agreement for lack of comminution (κ=0.42). These findings were independent of the time between fractures.

**CONCLUSION**

Patients with unilateral AFFs are likely to be diagnosed with a contralateral AFF within the first year of presentation. Bilateral fractures are likely to have similar imaging findings and location along the femur, regardless of the time interval between fractures.

**CLINICAL RELEVANCE/APPLICATION**

After diagnosing a unilateral AFF, surveillance of the contralateral femur is essential. Most contralateral fractures are similar in appearance and location to the index fracture.

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**Detection of Bone Marrow Edema for Diagnosis of Osteoporotic Thoracolumbar Vertebral Compression Fractures Using Dual-Energy CT in Correlation with MRI**

**PURPOSE**

To evaluate whether virtual non-calcium (VNC) dual-energy computed tomography (DECT) can improve the detection rate of acute thoracolumbar vertebral compression fractures in osteoporotic patients on CT in correlation with magnetic resonance imaging (MRI).

**METHOD AND MATERIALS**

In this prospective IRB-approved study, 31 patients with known osteoporosis and suspected acute vertebral compression fractures underwent second-generation DECT (80/140 kV) and MRI. Standard grayscale CT (M_0.4; bone kernel) and corresponding VNC-DECT reconstructions were calculated. Five blinded radiologists (1-7 years of experience in skeletal radiology) first evaluated the grayscale CT scans to detect vertebral compression fractures (acute and old). After each case, VNC fusion maps were evaluated to detect bone marrow edema indicative of acute fractures. Findings were compared with MRI as gold standard. Sensitivity, specificity, predictive values, intra- and interobserver agreements were calculated.

**RESULTS**

Compared with grayscale CT images, supplemental VNC-DECT showed a significantly higher (P<0.001) global sensitivity (95.1% vs. 70.1%), negative predictive value (NPV, 91.8% vs. 65.5%), and accuracy (90.2% vs. 77.7%). Specificity (83.0% vs. 89.6%) and positive predictive value (PPV, 89.4% vs. 91.4%) decreased due to increased false positive findings (23 vs.11). Differences regarding the detection of bone marrow edema between VNC-DECT and MRI were non-significant (P=0.417). Further analysis with the Youden-index confirmed a higher diagnostic performance for CT + VNC-DECT (0.780) compared to grayscale CT scans only (0.597; P<0.001). Global interobserver agreement regarding the evaluation of VNC-DECT series was substantial (intraclass correlation coefficient [ICC]: 0.655; 95% confidence intervals [CI]: 0.488, 0.779) while global intraobserver agreement between both CT image series was fair (ICC: 0.267; 95% CI: 0.080, 0.414).

**CONCLUSION**

VNC-DECT can accurately depict bone marrow edema in acute thoracolumbar vertebral compression fractures in osteoporotic patients with good correlation to MRI and significantly improves the detection rate of such fractures compared with grayscale CT scans.

**CLINICAL RELEVANCE/APPLICATION**

**Detection of Bone Marrow Edema for Diagnosis of Osteoporotic Thoracolumbar Vertebral Compression Fractures Using Dual-Energy CT in Correlation with MRI**

**SSJ16-06**

**Moritz  Kaup (Presenter): Nothing to Disclose , Julian Lukas  Wichmann  MD :  Nothing to Disclose , Jan-Erik  Scholtz :  Nothing to Disclose , Martin  Beeres  MD :  Nothing to Disclose , Josef  Matthias  Kerl  MD :  Nothing to Disclose , Wolfgang  Kromen :  Nothing to Disclose , Thomas  Lehnert  MD :  Nothing to Disclose , Moritz  Albrecht  MD :  Nothing to Disclose , Renate  Maria  Hammerstingl  MD :  Nothing to Disclose , Wolfgang  Kromen :  Nothing to Disclose , Thomas  Josef  Vogl  MD, PhD :  Nothing to Disclose , Ralf  W.  Bauer  MD :  Research Consultant, Siemens AG Speakers Bureau, Siemens AG**

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**Clinical Relevance/Application**

**Detection of Bone Marrow Edema for Diagnosis of Osteoporotic Thoracolumbar Vertebral Compression Fractures Using Dual-Energy CT in Correlation with MRI**

**SSJ16-06**

**Moritz  Kaup (Presenter): Nothing to Disclose , Julian Lukas  Wichmann  MD :  Nothing to Disclose , Jan-Erik  Scholtz :  Nothing to Disclose , Martin  Beeres  MD :  Nothing to Disclose , Josef  Matthias  Kerl  MD :  Nothing to Disclose , Wolfgang  Kromen :  Nothing to Disclose , Thomas  Lehnert  MD :  Nothing to Disclose , Moritz  Albrecht  MD :  Nothing to Disclose , Renate  Maria  Hammerstingl  MD :  Nothing to Disclose , Wolfgang  Kromen :  Nothing to Disclose , Thomas  Josef  Vogl  MD, PhD :  Nothing to Disclose , Ralf  W.  Bauer  MD :  Research Consultant, Siemens AG Speakers Bureau, Siemens AG**

**Purpose**

To evaluate whether virtual non-calcium (VNC) dual-energy computed tomography (DECT) can improve the detection rate of acute thoracolumbar vertebral compression fractures in osteoporotic patients on CT in correlation with magnetic resonance imaging (MRI).

**Method and Materials**

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**Conclusion**

VNC-DECT can accurately depict bone marrow edema in acute thoracolumbar vertebral compression fractures in osteoporotic patients with good correlation to MRI and significantly improves the detection rate of such fractures compared with grayscale CT scans.

**Clinical Relevance/Application**
DECT can significantly improve the detection rate of acute vertebral compression fractures on CT imaging and may be especially beneficial for patients with contraindications for MRI.

SSJ17
Neuroradiology/Head and Neck (ENT Oncology)

SSJ17-01
Proposal of a Sequential Clinico-Radiological Protocol for Aetiological Characterisation of Cervical Lymphadenopathy by Comparing the Accuracies of Ultrasonography (USG), Elastography and MDCT

Sravanthi Mantripragada MBBS (Presenter): Nothing to Disclose, Raja Sekaran Kattumannarkudi Ramalingam MBBS: Nothing to Disclose, Meera Krishnakumar DMRD, MD: Nothing to Disclose

PURPOSE
To determine the most accurate modality and propose a sequential protocol for cause identification of cervical lymphadenopathy.

METHOD AND MATERIALS
The study population consisted of 121 nodes and a control of 11 reactive nodes. USG and Strain elastography were performed with an Acuson S2000 unit. ImageJ software was used to analyse Elastographic images. MDCT was performed using a Toshiba 64 slice scanner. Based on characteristics like size, shape, reticulation, type of vascularity, hilar echogenicity, necrosis, matting, percentage of elastographic stiffness, nodes were diagnosed and compared with the final HPE diagnosis. Accuracy of each modality (USG, combination of USG and Elastography and MDCT) was estimated by calculating the sensitivity, specificity, PPV and NPV for each aetiology (Lymphoma, TB, Metastasis and Reactive). The modalities were compared in pairs to determine the most accurate modality for cause characterization. P-values, PPV, NPV and PLR for certain characteristics of USG and MDCT which favoured some aetiologies were calculated. The data was analysed using Fisher’s exact test and Pearson’s Chi-squared test. A p value <0.05 was considered significant.

RESULTS
USG was the most accurate modality, followed by MDCT and combination of USG and Elastography, in that order. On USG: -Intranodal reticulation with posterior acoustic enhancement implies Lymphoma -Displaced vascularity or necrosis and matting implies TB -Hilar vascularity implies Reactive -Peripheral or mixed vascularity imply Metastasis
On MDCT: -Heterogeneous enhancement and low attenuation centres (not necrosis) implies Metastasis -Thick nodular capsular enhancement with internal septae or matting or peripheral/multilocular enhancement or necrosis implies TB

CONCLUSION
USG is the preferred modality for cause characterization of cervical lymphadenopathy. Elastography significantly reduces the accuracy of USG, when used in tandem, especially in cases of TB. This implies that Elastography has very limited application in the cause characterization of cervical lymphadenopathy. TB significantly reduces the accuracy of ultrasound modalities in cause determination.

CLINICAL RELEVANCE/APPLICATION
This study proposes a low-cost, low-radiation standard clinico-radiological step-by-step protocol (in fig) for approach to cervical lymphadenopathy, which is of practical application.

SSJ17-02
Comparison of Accuracies between US-guided Fine Needle Aspiration and US-guided Core Needle Biopsy to Detect Malignancy and to Make Tissue-specific Diagnosis of Salivary Gland Tumors

Seung-Won Jang MD (Presenter): Nothing to Disclose, Hye Joung Eom MD: Nothing to Disclose, Myung-Su Ko MD: Nothing to Disclose, Jeong Hyun Lee MD, PhD: Nothing to Disclose, Young Jun Choi MD: Nothing to Disclose, Ragyoung Yoon MD: Nothing to Disclose, Jung Hwan Baek: Nothing to Disclose

PURPOSE
To compare the diagnostic accuracies of ultrasonography-guided fine needle aspiration (USFNA) and core needle biopsy (CNB) for the detection of malignancy and tissue-specific diagnosis of salivary gland tumors.
To compare the diagnostic accuracies of ultrasonography-guided fine needle aspiration (USFNA) and core needle biopsy (USCNB) for detecting malignant tumors of the salivary gland and for tissue-specific diagnosis of benign and malignant tumors in a tertiary hospital.

**METHOD AND MATERIALS**

This retrospective study was approved by our institutional review board and informed consents were waived. From 2003 to 2012, 354 consecutive patients underwent USFNA (n = 121) or USCNB (n = 233) for a salivary gland mass. Among them we included 320 patients confirmed either by surgery (n = 248) or clinical follow-up > 1-year (n = 72) after exclusion of non-diagnostic results (n = 13) or follow-up loss (n = 21). We compared the diagnostic accuracies between USFNA and USCNB for discriminating malignant salivary gland tumors and for correct tissue-specific diagnosis of benign and malignant tumors. We also tested any difference between the procedures according to the operator’s experience level.

**RESULTS**

Non-diagnostic rates were significantly higher in USFNA with 6.7 % (7/104) than USCNB with 2.6 % (6/229), respectively. The overall accuracy of USCNB for diagnosing malignant tumors was significantly higher than that of USFNA (p = 0.026). Correct tissue-specific diagnosis for benign and malignant tumors was in 97 % and 53 % with USFNA and 96 % and 82 % with USCNB. The accuracy for diagnosing malignant tumors was significantly higher with USCNB than USFNA among the results by trainees, but there was no difference among the results by faculty. There was no significant complication needed intervention or hospitalization in our cohort.

**CONCLUSION**

USCNB should be the choice for diagnosis of a salivary gland mass because it is better in discriminating malignant tumors from benign and in tissue-specific diagnosis of benign and malignant tumors.

**CLINICAL RELEVANCE/APPLICATION**

Ultrasonography-guided core needle biopsy is superior to fine needle aspiration in diagnosis of malignant tumors of the salivary gland.

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**SSJ17-03**

The Incremental Value of Diffusion Weighted Imaging over Conventional MRI for Detection of Metastatic Nodes in Squamous Carcinoma of the Oral Tongue: Do We See the Glass Half Full or Half Empty?

Supreeta Arya MD (Presenter): Nothing to Disclose, Sonal Mahalwar MBBS : Nothing to Disclose, Nilesh Sable : Nothing to Disclose

**PURPOSE**

To determine the incremental value of diffusion-weighted MR imaging over conventional MRI in the detection of metastatic lymph nodes in oral tongue squamous cell carcinoma (SCC).

**METHOD AND MATERIALS**

A prospective study was undertaken in 30 patients of stage T2 - T4 oral tongue SCC at a tertiary referral oncology centre. Cases receiving neoadjuvant therapy were excluded. All cases underwent MRI on a 1.5T magnet. Multiplanar spin echo sequences (T1W, T2W, STIR and postgadolinium T1W) were obtained for conventional MRI. DWIMRI was performed using b0 and b1000 values. ADC maps were used for calculating ADC values for nodes at each nodal station (IA, IB, II-V). All cases underwent elective neck dissection, either unilateral (n= 16) or bilateral (n=14). In all 44 necks were operated; modified radical neck dissection (MRND) in unilateral dissections and MRND/supra-omohyoid neck dissection on the contralateral side. The imaging findings were correlated with histopathology, both on a per neck basis and per nodal station level basis. Institutional review board clearance was obtained before recruiting patients for the study.

**RESULTS**

Conventional MR imaging using all criteria revealed a sensitivity of 66.6%, specificity of 90%, PPV of 88.8 %, NPV 69.2 %, and accuracy of 77.2 %, on a per neck basis. On a per nodal station basis, a sensitivity of 63.8%, specificity of 90.9%, positive predictive value (PPV) of 69.6 %, negative predictive value (NPV) of 88.5% and accuracy of 84.2% were obtained. There was significant overlap in the range of ADC values of benign and metastatic nodes. The cut off ADC value obtained from the ROC curve was 0.95x10-3mm2. Using this ADC value the incremental value of DWMRI over conventional MRI yielded a sensitivity of 77.5%, specificity of 77.2 %, positive predictive value of 50.8%, negative predictive value of 92 % and accuracy of 77.3%.

**CONCLUSION**

DWI MRI added to conventional MRI increased sensitivity and NPV, but due to overlap in ADC values of metastatic and reactive nodes, the PPV reduced significantly. DWI of lymph nodes may not be as accurate as initially reported in literature.

**CLINICAL RELEVANCE/APPLICATION**

The debate between elective neck dissection and watchful waiting for the clinically negative neck is not yet settled. DWI MRI cannot improve surgical staging; but if watchful waiting is the decided policy, adding DWI-MRI to conventional MRI could contribute by an increase in NPV.

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**SSJ17-04**

Could Contrast-enhanced CT Examination Add Diagnostic Value over US-based Detection of Metastatic Neck Lymph Nodes in Patients with Thyroid Cancer?: A Prospective, Multicenter Study. Korean Society of Thyroid Radiology (KSThR) Study Group
PURPOSE

To determine an additional diagnostic role of combined US/CT over the US evaluation for detection of metastatic LNs in patients with thyroid cancers.

METHOD AND MATERIALS

During the recent 1 year, 9 experienced head and neck radiologists in seven institutions prospectively evaluated the both I~VI neck LN levels of patients with thyroid cancers prior to operation using both ultrasound (US) and contrast-enhanced neck CT. Imaging criteria of probably metastatic LN were as followed [US]: calcification, cystic change, hyperechoic, abnormal vascular pattern; [CT]: calcification, cystic change, strong enhancement without hilar vessel, heterogeneous enhancement. If at least one of above mentioned criteria to suggest probably metastatic were found, we considered the corresponding LN level as probably metastatic. Finally, we enrolled pathologically proven 801 nodal levels (benign: malignant=418: 383; central: lateral: others =531:263: 7) from 353 patients (M:F=77:276, mean age: 47.0±12.3 years) with thyroid cancer (mean size: 13.5 ±10.5mm). Based on their pathologic results, the diagnostic performances of US, and combined US/CT classifications were compared by Mcnemar test.

RESULTS

Our level by level and patient-based analysis revealed that combined US/CT imaging criteria significantly improved the sensitivities (p<0.01), and decreased the specificities (p<0.01), while not affected the diagnostic accuracies (p>0.05) in the overall, central and lateral neck levels, compared to US-only, except the more higher diagnostic accuracies achieved only in lateral neck by combined US/CT criteria (p=0.011). Moreover, the sensitivities of CT criteria to detect additional metastatic LNs in lateral neck were 54.8% (23/42 levels) and 65.5% (19/29 persons) in cases of LNs which were not considered as probably metastatic by US criteria.

CONCLUSION

For preoperative neck LN evaluation, US/CT combined evaluation could play additional diagnostic roles in patients with thyroid cancers, especially in lateral neck, compared to US-based evaluation.

CLINICAL RELEVANCE/APPLICATION

For preoperative neck LN evaluation, US/CT combined evaluation could play additional diagnostic roles in patients with thyroid cancers, especially in lateral neck, compared to US-based evaluation.

**SSJ17-05**

**Head and Neck Neoplasms: Correlation of CT Perfusion Imaging with Microvessel Density and Cascular Endothelial Growth Factor**

Zuohua Tang MS, MD (Presenter): Nothing to Disclose, Jie Wang: Nothing to Disclose, Lingjie Wu MD: Nothing to Disclose

PURPOSE

To evaluate the value of perfusion CT (CTP), microvessel density (MVD), and vascular endothelial growth factor (VEGF) in the differentiation of malignant from benign head and neck neoplasms (HNNs).

METHOD AND MATERIALS

Forty-one HNNs proven by pathology underwent CTP, MVD, and VEGF analysis. All lesions were divided into three groups: Group A, benign hypovascular lesions; Group B, benign hypervascular lesions; and Group C, malignant lesions. A time density curve (TDC) and CTP parameters (MIP, BV, BF, MTT, CP) were analysed. The relationship between the perfusion measurements and MVD/VEGF was assessed by Pearson correlation.

RESULTS

The TDCs could be classified into three types. TDC of type I was mainly found in Group A, and type II was found in Groups B and C. MIP, BF, and BV were all significantly higher in Groups B and C compared to Group A (all P < 0.01). Pearson correlation showed a positive correlation between the MVD and MIP, BV, and VEGF, respectively (all P<0.05). The VEGF expression in Group C was significantly higher than that in Groups A and B (all P<0.05).

CONCLUSION

The MIP and BV of CTP correlate positively with MVD and may reflect angiogenesis of HNNs. CTP combined with VEGF could be beneficial by allowing differentiation of malignant from benign HNNs.

CLINICAL RELEVANCE/APPLICATION

CTP may reflect angiogenesis of head and neck neoplasms (HNNs) and is helpful in the differentiation of malignant from benign HNNs and is recommended in the initial evaluation of HNNs.
**SSJ16-06**

**Negative High-resolution Salivary Gland Ultrasound: Highly Predictive of Negative Labial Gland Biopsy in Patients with Sicca Symptoms**

Juveria Siddiqui MBBS, MRCS (Presenter): Nothing to Disclose, Elisa Astorri: Nothing to Disclose, Anwar Tappuni: Nothing to Disclose, Nurhan Sutcliffe MBBS: Nothing to Disclose, Michele Bombardieri: Nothing to Disclose, Polly Richards MD: Nothing to Disclose

**PURPOSE**

Sjogren’s syndrome (SS) is a chronic autoimmune condition affecting both the salivary and lacrimal glands, with resultant xerostomia and keratoconjunctivitis sicca. American-European Consensus Group (AECG) criteria mandates a positive labial salivary gland biopsy (LSGB) for diagnosis, if anti-Ro/La antibody (ENA) tests are negative, in order to distinguish SS from alternative causes of sicca. Due to the high specificity and poor sensitivity of invasive LSGB, it is often reserved for symptomatic ENA positive patients. This study investigates the value of high resolution salivary gland ultrasound (US) in predicting positive LSGB in patients with sicca symptoms.

**METHOD AND MATERIALS**

The US and LSGB reports of 85 consecutive patients attending the SS clinic were compared. All patients had clinical sicca. Major salivary gland US was performed by experienced sonographers and assessed using the modified Salaffi score (>1 is abnormal). Experienced histopathologists utilised the Chisholm and Mason focus score confirmed by immunohistology for CD3/CD20/CD138/CD21 in LSGB evaluation. Both reports were assessed blindly, independent of clinical data.

**RESULTS**

Out of the 85 patients, 20 were ENA positive (23.5%). 31 patients had a positive LSGB, 15 of whom were ENA positive and 16 of whom were ENA negative. Thus 36 patients met diagnostic criteria for SS, with the remaining 49 classified as sicca only. Abnormal US findings were seen in 34 patients (40%); notably 29 of these patients diagnosed as LSGB positive, giving a significant concordance between the two techniques of 91.76% (Kappa 0.826). Irrespective of diagnosis and ENA status, a negative US gave a negative LSGB predictive value of 96.08% while the positive predictive value of a positive LSGB with abnormal US findings was 85.29%.

**CONCLUSION**

This data suggests that a negative US is highly predictive of negative LSGB, in patients with clinical sicca. This is important in ENA negative patients, where LSGB results are most relevant. We propose the incorporation of ultrasound into the SS diagnostic algorithm for risk stratification, with a view to avoiding invasive biopsy in low risk patients.

**CLINICAL RELEVANCE/APPLICATION**

Negative ultrasound is highly predictive of negative labial salivary gland biopsy in our patient group. Incorporation of this investigation into a diagnostic algorithm for patients with sicca could prevent invasive biopsy in low risk patients.

**SSJ18**

**Neuroradiology (Epilepsy)**

**Scientific Papers**

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**Participants**

Moderator
Steven Marshall Stufflebeam MD: Nothing to Disclose

Moderator
Roland Robert Lee MD: Nothing to Disclose

**Sub-Events**

**SSJ18-01**

**Evaluation of the Capability of Arterial Spin Labeling to Depict the Seizure Focus in Patients with Clinical Seizure Activity**

Beom Su Kim MD (Presenter): Nothing to Disclose, Beom Su Kim MD: Nothing to Disclose, Tae Jin Yun MD: Nothing to Disclose, Jin Chul Paeng: Nothing to Disclose, Seung Hong Choi MD, PhD: Nothing to Disclose, Ji-hoon Kim MD: Nothing to Disclose, Chul-Ho Sohn MD: Nothing to Disclose, Roh-Eul Yoo MD: Nothing to Disclose, Jung Hyo Rhim MD, PhD: Nothing to Disclose

**PURPOSE**

The capability of arterial spin labeling (ASL) MR to depict the seizure focus in patients with clinical seizure activity has not yet been elucidated. We aimed to assess the relative capability of ASL to depict the seizure focus compared with electroencephalogram (EEG) in patients with clinical seizure activity.

**METHOD AND MATERIALS**

This retrospective study was approved by the institutional review board, and informed consent requirement was obtained.
This retrospective study was approved by the institutional review board, and informed consent requirement was waived. Consecutive postictal ASL images from 36 patients with clinical seizure activity were analyzed. All patients underwent both EEG and MR imaging using ASL technique after clinical seizure activity. Eight of the patients also underwent 99mTc-HMPAO single-photon emission computed tomography after clinical seizure activity. The area under the receiver operating characteristic curve was used to evaluate diagnostic accuracy of ASL relative to that of EEG. Diagnostic performance of ASL images to depict the location of seizure focus was evaluated using EEG as the gold standard.

RESULTS
The area under the receiver operating characteristic curve of ASL to depict the seizure focus was 0.903 (95% confidence interval: 0.756 - 0.976, p < 0.0001). In terms of diagnostic performance of ASL to depict the seizure focus, there was a sensitivity of 87% (26/30), a specificity of 33% (2/6), a positive predictive value of 87% (26/30), and a negative predictive value of 33% (2/6). Of 8 patients who underwent single-photon emission computed tomography images after clinical seizure activity, all patients showed perfusion abnormality. Among the patients, concordance was revealed in all 7 patients in terms of seizure location.

CONCLUSION
ASL can depict the seizure focus with excellent performance in patients with clinical seizure activity and has the potential to serve as a non-invasive imaging tool for detection of seizure focus in the patients.

CLINICAL RELEVANCE/APPLICATION
ASL can depict the seizure focus with excellent performance in patients with clinical seizure activity. ASL has the potential to serve as a non-invasive imaging tool for detection of seizure focus in the patients.
Our study aimed to examine extratemporal abnormalities of cerebral parenchyma in young adult TLE patients, using DTI.

METHOD AND MATERIALS

The study comprised 20 adults with unilateral TLE and 20 controls. We calculated fractional anisotropy (FA), apparent diffusion coefficient (ADC), parallel eigenvalue ($\lambda//$) and perpendicular eigenvalue ($\lambda?$) in the ROIs using a 3-T MRI scanner. ROIs included: anterior/posterior limb of the internal capsule (AIC/PIC), external capsule (EC), head of caudate nucleus (HCN), lenticular nucleus (LN), thalamus (TL) and genu/ body / splenium of the corpus callosum (GCC/BCC/SCC).

RESULTS

Compared to controls, TLE patients showed: lower FA in all ROIs; higher ADC in bilateral ECs, HCNs, TLs and BCC; lower $\lambda//$ in ipsilateral LN and bilateral AICs, TL and GCC; higher $\lambda?$ in all ROIs except the bilateral PICs. In TLE patients, the ipsilateral TL had decreased FA compared with the contralateral TL. Pearson correlation analysis revealed a negative correlation between ADC of GCC and the epilepsy onset age, $\lambda//$ of ipsilateral PIC and the epilepsy onset age, $\lambda?$ of contralateral AIC and the duration of epilepsy, respectively; and a positive correlation between ADC of GCC and the duration of epilepsy, $\lambda?$ of GCC and the duration of epilepsy, respectively.

CONCLUSION

The study revealed bilateral extratemporal abnormalities in young adult TLE patients compared with controls; and TLE patients with younger onset age or longer duration of epilepsy may have more serious extratemporal changes.

CLINICAL RELEVANCE/APPLICATION

fMRI

SSJ18-04  
Stereotactic Amygdalohippocampectomy and Anterior Temporal Resection for Mesial Temporal Lobe Epilepsy: Resection or Destruction Extent versus Seizure and Neuropsychological Outcomes

Hana Malikova MD (Presenter): Nothing to Disclose, Lenka Kramska : Nothing to Disclose, Zdenek Vojtech MD : Nothing to Disclose, Roman Liscak PhD : Nothing to Disclose

PURPOSE

Surgical therapy of intractable mesial temporal lobe epilepsy (MTLE) is an effective and well-established treatment that brings seizure relief in 60-70% of patients. Anterior temporal resection (ATL) is commonly used surgical procedure. Stereotactic radiofrequency amygdalohippocampectomy (SAHE) is a minimally invasive selective approach. It is known that the surgical treatment of MTLE bears the risk of memory impairment especially in left-sided surgery. The aim of the study was to compare 2 different surgical approaches, standard ATL and alternative SAHE for MTLE, with respect to the extent of resection or destruction, and clinical outcomes.

METHOD AND MATERIALS

75 MTLE patients were included; 41 treated by SAHE (11 right-sided, 30 left-sided) and 34 treated by ATL (21 right-sided, 13 left-sided). All patients underwent MRI volumetry of hippocampus and amygdala and neuropsychological evaluation preoperatively and 1 year after operation. Clinical seizure outcome was assessed 2 years after therapy.

RESULTS

Hippocampal (60.6±18.7%) and amygdalar (50.3±21.9%) volume reduction by SAHE was significantly lower than by ATL (86.0±12.7%, 80.2±20.9%, respectively). Seizure control by SAHE was comparable with ATL (Engel I in 75.6% and 76.5%) 2 years after surgery. Neuropsychological results of SAHE patients were better than in ATL patients. In SAHE patients no memory impairment was found, they improved in Global MQ and Verbal MQ. In ATL group, memory performance was significantly deteriorated only in Delayed Recall.

CONCLUSION

In this study we have proven that destruction of hippocampal and amygdalar tissue by SAHE was significantly lower than hippocampal and amygdalar resection after ATL. Seizure control by SAHE was comparable to ATL. However, SAHE offers better neuropsychological results.

CLINICAL RELEVANCE/APPLICATION

SAHE is minimally invasive selective treatment for MTLE that partialy spares mesial structures of temporal lobe and offers comparable seizure control as ATL, with better neuropsychological results.

SSJ18-05  
Intraoperative MRI in Anterior Temporal Lobectomy for Mesial Temporal Lobe Epilepsy: Does Intraoperative MRI Improve the Resection Extent?

Hana Malikova MD (Presenter): Nothing to Disclose, Zdenek Vojtech MD : Nothing to Disclose, Jan Sroubek : Nothing to Disclose
PURPOSE
Mesial temporal lobe epilepsy (MTLE) is the most common epilepsy diagnosis in adults. Surgery brings seizure relief in 60-70% of patients. Anterior temporal resection (ATL) is commonly used for surgical therapy. The resection extent of mesial structures is often discussed in literature and it is known that the amount of resected tissues often varies considerably. The aim of the study was to compare the resection extent and complication rate in patients with and without intraoperative MRI evaluation during ATL procedure.

METHOD AND MATERIALS
We included 34 MTLE patients treated by ATL for MTLE: 13 of them underwent intraoperative MRI evaluation of the resection extent and 21 patients did not. MRI volumetry of mesial temporal structures was done preoperatively and 1 year after ATL.

RESULTS
In patients without intraoperative MRI, the volume resection of the hippocampus was 89.1±10.7% and of the amygdala was 77.4±23.6%. In patients with intraoperative MRI, the volume resection of the hippocampus was 83.2±14.3% and of the amygdala was 84.8±15.4%. The following complications were observed in patients without intraoperative MRI: 4.8% of purulent meningitis; 4.8% of clinically silent infarction; 4.8% manifest infarction (1 case with transient dysphasia). In patients with intraoperative MRI the following complications developed: 15.4% of clinically non-silent infarctions (one case with transient dysphasia, one case with transient hemiparesis); 15.4% of silent infarctions. We did not find any death cases or persistent neurological deficit more than 1 year after ATL. Two years after ATL both groups had comparable seizure control, 84.6% patients were seizure free in group with intraoperative MRI and 71.4% without intraoperative MRI.

CONCLUSION
Intraoperative MRI evaluation brought more ischemic complications without effect on the resection extent. We speculate that intraoperative MRI brings more infarctions due to the prolonged time of operation (approximately 1 hour more) probably vasospasm may play a role.

CLINICAL RELEVANCE/APPLICATION
Intraoperative MRI evaluation of the resection extent in case of ATL should be carefully considered due to the risk more ischemic complications.

SSJ18-06

CT Perfusion (CTP) Changes in Seizure Patients Presenting with Stroke-like Symptoms: Correlation with Clinical and Electroencephalography (EEG) Findings

PURPOSE
To determine the CTP changes in seizure patients presenting with stroke-like symptoms and its correlation with clinical presentation and EEG results.

METHOD AND MATERIALS
The clinical and imaging records of all patients who presented to our emergency department with stroke-like symptoms and underwent CTP, from 1/2006 to 7/2011, were reviewed. Those patients without stroke (as per follow up imaging) who were clinically diagnosed with seizure were included. In those patients with unilateral hyperemia on CTP scan, relative CBV, CBF, and MTT of the hyperperfused regions were calculated compared to contralateral side.

RESULTS
From 1085 CTP examinations over 5.5 years, 21 patients were included. The average age at the time of presentation was 40 ± 12.2 years; and average time gap between the symptom onset and CTP scan was 2.3 ± 1.4 hours. Of note, 11 (52%) patients had history of prior seizure, and 9 (43%) were on antiepileptic medications at presentation. Unilateral hyperemia was found in 16 (76%) patients (10 in the left cerebral hemisphere); and the remaining 5 patients had symmetric perfusion on CTP. Temporal lobe was involved in 14/16 patients with unilateral hyperemia. Compared to patients with symmetric perfusion, those with unilateral hyperemia had higher rate of contralateral motor deficit and/or aphasia at presentation (12/16 vs 1/5, P=0.047); whereas the common presentation of those patients with symmetric perfusion scan was altered mental status (3/5 vs 1/16, p=0.028). Among those patients with unilateral hyperemia and abnormal EEG (n=13), 4/13 had unilateral fast/spike epileptiform discharge, which was associated with higher relative CBF (2 ± 0.3 vs 1.5 ± 3.7, p=0.034) and lower relative MTT (0.47 ± 0.05 vs 0.93 ± 0.34, p=0.030) compared to patients with diffuse or unilateral slowed EEG waves.

CONCLUSION
Seizure patients presenting with unilateral motor deficit or aphasia commonly have contralateral hyperemia on CTP scan; whereas, those presenting with altered mental status in the absence of lateralized motor deficit commonly have symmetric perfusion study. Moreover, lateralized fast epileptiform discharge on EEG is associated with ipsilateral high relative CBF and low MTT.
The correlation between CTP changes and clinical/EEG findings in seizure patients can potentially be used for diagnosis, prognostication, treatment follow up and therapy guidance in these patients.

### Carotid Angioplasty and Stenting: Long-term Outcomes in Radiation Associated Stenosis

**Chun Kit Shiu MBBS, FRCR (Presenter): Nothing to Disclose, Joyce Pui Kwan Chan: Nothing to Disclose, Sherman Sheung Ming Lo MBBS, MPH : Nothing to Disclose, Wai Lun Poon MBBS, FRCR : Nothing to Disclose**

**PURPOSE**

This retrospective study aims at comparing the short-term and long-term outcomes of carotid angioplasty and stenting (CAS) between patients suffering from radiation-associated carotid stenosis and those with atherosclerosis-associated stenosis.

**METHOD AND MATERIALS**

All consecutive patients who underwent CAS in our institution for carotid stenosis between Jan 2008 and Dec 2013 were identified. According to any history of head and neck irradiation, patients were stratified into radiation treatment (XRT) or non-XRT group. All CAS were performed by a dedicated team of neurointerventionists. Standardized post-operative clinical and Doppler ultrasound follow-up were undertaken for all patients. Diagnostic angiograms were performed to confirm the restenosis (>70%) detected by Doppler studies. Procedural and clinical records were reviewed and any periprocedural events and long-term recurrent stroke were documented. Univariate and Kaplan-Meier analyses were performed for both groups.

**RESULTS**

114 CAS procedures were identified. There were 41 patients with 46 CAS in XRT group and 68 patients with 78 CAS in non-XRT group. 15 patients received bilateral CAS. Median follow-up for XRT and non-XRT were 25.6 and 24.8 months. XRT patients were younger (63.5 vs. 73.1 years; p<0.001) and with significantly less vascular risk factors. 37 (90%) XRT patients had irradiation for nasopharyngeal carcinoma. More XRT patients had CCA stenosis (52.1% vs. 6.4%; p<0.001) and significantly longer segment of stenosis. The perioperative events including stroke, myocardial infarction and mortality did not differ significantly between the two groups but only 1 (2.2%) patient in XRT had stroke compared with 8 (10.3%) in non-XRT. Although there was no statistically significant difference in long-term mortality and ipsilateral stroke between XRT and non-XRT group, likely due to a small sample size, a trend towards better outcomes in XRT group can be observed. Restenosis was significantly more common in XRT compared with non-XRT (p=0.043). Majority of the restenosis were asymptomatic.

**CONCLUSION**

This study shows the perioperative and long-term outcomes of CAS in radiation-associated stenosis are comparable to that in atherosclerotic stenosis, except for a higher restenosis rate.

**CLINICAL RELEVANCE/APPLICATION**

CAS in radiation-associated stenosis is probably safe and efficacious and we recommend a more frequent follow-up in these patients due to a higher restenosis rate.
**Purpose**

Long-term data on aneurysm treatment with flow-diverting stents are still sparse and follow-up protocols differ widely between institutions. We present long-term results, with a focus on the usefulness of 3T-MRI including contrast-enhanced MR-angiography (ceMRA).

**Method and Materials**

Patients with aneurysms treated by flow-diverting stents without additional coiling and follow-up MRI after at least six months were included. 3T-MRI protocol included dedicated ceMRA in arterial and venous phase. Aneurysm thrombosis, size of the aneurysmal sac and complications were evaluated. Additionally, we graded the ability of MRI with ceMRA to visualize these parameters on a 1 - 3 scale.

**Results**

Twenty-one patients were included. Aneurysms were incidental in 15 cases and symptomatic in six cases (all cranial nerve palsies, no acute subarachnoid haemorrhage). Stenting was performed with 'Pipeline' in 17 cases and 'Silk' stents in four cases. Four technical complications occurred, one of which caused clinically apparent ischaemia. Duration of follow-up was more than two years in 16 patients. Complete occlusion of the aneurysm occurred in 18 cases (86%). Of 13 cases in which a three-month-follow-up was available, seven were occluded at that time (54%). At six months, 18 aneurysms were occluded (86%). The aneurysmal sac shrunk in 16 of the 18 occluded aneurysms, in 11 cases to less than 50% of the original size. On follow-up, one small perianeurysmal haemorrhage and one in-stent stenosis were found on MRI. Three of the symptomatic patients improved clinically. CeMRA assessability of aneurysmal thrombosis and size of the aneurysmal sack was graded as good in all cases. Where available, no discrepancies were found between ceMRA and digital subtraction angiography regarding aneurysm perfusion. Assessability of the stent lumen was reduced in cases treated with 'Pipeline' and good in cases treated with 'Silk'.

**Conclusion**

Flow-diverter treatment can achieve high occlusion rates and cause major aneurysm shrinkage in many cases. MRI with ceMRA proved highly valuable regarding imaging of the aneurysm and late complications. The assessability of the stent lumen on ceMRA depends on the stent type.

**Clinical Relevance/Application**

Our study adds to the understanding of the development of aneurysm thrombosis and shrinkage after flow-diverter treatment and presents 3T-MRI with ceMRA as a highly valuable follow-up imaging tool.

### Microembolism after Endovascular Treatment of Unruptured Cerebral Aneurysms: Incidence and Risk Factor Analysis

**Purpose**

To analyze the incidence and risk factors of microembolic lesions on diffusion-weighted imaging (DWI) after endovascular coiling of unruptured intracranial aneurysms.

**Method and Materials**

From Jul. 2011 to Jun. 2013, we had 271 consecutive cases (70 men and 201 women, median age of 57 with a range of 23-79) of unruptured aneurysm embolization. Aneurysm location was in the anterior circulation in 226 and posterior circulation in 45. Multiple aneurysms were seen in 37. Maximum diameter of the index aneurysm was 5 mm in median (range: 2.2-21). Procedures were done by simple coiling (n=91), stent assisted (n=105), balloon assisted (n=16), or multiple microcatheters (n=59) using various types of detachment coils. Total number of coils was 5 in median (range, 2-23). Procedure duration ranged from 20 to 235 (median, 61) minutes. Any coil loop herniation was seen in 37. Overt thromboembolic phenomenon which required use of thrombolytics was noted in 5. Intra-procedural rupture occurred in 4. DWI was obtained the following day to see occurrence of any microembolic lesion. 2 independent reviewers were analyzed the presence of any microembolic lesion and counted the lesion number. Multivariate analysis was done to find independent risk factors of microembolism.

**Results**

Microembolic lesions were noted in 101 (37.3%). The number was less than 5 in 70.3%. Multivariate analysis showed various statistically significant factors which included age (OR: 1.04, p=0.01), diabetes (OR: 3.21, p=0.002), previous history of ischemic stroke (OR: 3.58, p=0.044), white matter FLAIR HSI (OR: 5.48, p=0.001), multiple aneurysms (OR:3.08, p=0.018), and stent-assisted technique with Enterprise stent (OR: 10.7, p<0.001) Previously known risk factors such as prolonged procedure duration, aneurysm size, or decreased antiplatelet function did not show any significant influence.

**Conclusion**

The incidence of DWI high signal lesions after coiling of unruptured aneurysms was not low even though most of them were asymptomatic. It occurred more frequently in patients with vulnerable vascular status. Multiplicity of aneurysm and stent type also influenced its occurrence.
**CLINICAL RELEVANCE/APPLICATION**

Care should be taken to reduce the incidence of post-procedural microembolic lesions after coiling of unruptured cerebral aneurysms in patients with vulnerable vascular status.

### SSJ19-04

**Delayed Complications after Flow-diverter Stenting: Reactive In-stent Stenosis and Creeping Stents**

John Moshe Gomori MD (Presenter): Consultant, Medymatch Technology Ltd, Jose Enrique Cohen MD: Nothing to Disclose

**PURPOSE**

Assess the frequency and severity of changes in stent configuration and location, and patterns of in-stent stenosis of flow diverter stents.

**METHOD AND MATERIALS**

Retrospective review of consecutive data from October 2011 to July 2012 of Silk flow diverter [Balt Extrusion, Montmorency, France] and Pipeline embolization device [ev3/Covidien, Minneapolis, MN, USA]. Routine 2, 6, 9-12, and 16-20 month follow-up angiograms were compared, with a focus on changes between stent configuration and location immediately after deployment and on angiographic follow-up, and the incidence and development of in-stent stenosis.

**RESULTS**

Thirty-four patients with 42 aneurysms met inclusion criteria. The Silk device was implanted in 16 patients (47%, single device in 15), the Pipeline device in 18 (53%, single device in 16). On first follow-up angiography, in-stent stenosis was observed in 38% of Silk devices and 39% of Pipeline devices. In-stent stenosis was asymptomatic 12/13 patients. One woman presented with transient ischemic attacks and required stent angioplasty due to end tapering and mild, diffuse in-stent stenosis. Configuration and location changes such as stent creeping and end tapering were seen in 2/16 patients (13%) with Silk devices, and 0/18 patients with Pipeline devices. We describe stent creeping and end tapering among the unusual findings with potential for delayed clinical complications.

**CONCLUSION**

In-stent stenosis, with a unique behavior, is a frequent angiographic finding observed after flow-diverter stent implant. The stenosis is usually asymptomatic; however, close clinical and angiographic monitoring is mandatory for individualized management. Stent creeping and end tapering is more common with Silk devices.

**CLINICAL RELEVANCE/APPLICATION**

Silk diverter stents are less stable than Pipeline devices. Both devices show instent stenosis and need careful monitoring.

### SSJ19-05

**Large and Giant Intracranial Aneurysms Treated with Pipeline Embolization Device — MR-MRA Imaging Primary Findings: A Single Center Experience**

Carolina Parada MD (Presenter): Nothing to Disclose, Jorge Pablo Chudyk MD: Nothing to Disclose, Hector Eduardo Lambre MD: Nothing to Disclose, Pedro Lylyk MD: Consultant, Medtronic, Inc Consultant, Surpass Medical Ltd Consultant, Cardiatis SA

**PURPOSE**

Data including long-term follow up imaging using MR-MRA in the evolution of large and giant intracranial aneurysms treated with PED is still missing. We report our experience in the review and analysis of the primary MR-MRA findings on the evolution of these challenging aneurysms after treatment.

**METHOD AND MATERIALS**

From a total of 570 intracranial aneurysms treated with PED in a period between 2006 and 2013 a total of 92 were included with the following criteria: 1) large and giant intracranial aneurysms treated with PED and 2) MR-MRA follow up. All imaging studies were performed every 6 months the first year, and annually after that, with a 3T magnet (Philips Healthcare, Best, the Netherlands) and included FLAIR, T1, T2, MRA and postgadolinium T1.

**RESULTS**

76% aneurysms were located in the anterior circulation being 58% supraclinoid and the remaining 24% originated at the posterior circulation with 64% at the basilar trunk. The MRA showed complete occlusion in 66% with most of them occluded in a six month period after treatment, 79% of these from the anterior circulation and 21% from the posterior circulation. The postgadolinium T1 from the DSA confirmed occluded group showed enhancement of the sac in 31% in less than one year after treatment, finding that could be related to complete endothelialization. 34% aneurysms showed signs of residual neck or sac with a predominance of the C7 segment. The MRA also revealed shrinkage and total regression of the aneurysms in 60% with a dominance of the supraclinoid segment (40%) while 32% remain without changes in size and 8% showed an increase of size with predominance of the anterior circulation (80%). The aneurysms parenchymal environment was examined reporting 79% with no surroundings alterations and 21% with perilesional edema that showed resolution after treatment.
CONCLUSION

MRA absence of signal intensity of the occluded aneurysms after treatment that show postgadolinium T1 enhancement of the sac does not mean permeability of the lumen although could suggest complete endothelialization. The results also support the reliability of the use of PED in the treatment of this challenging aneurysms.

CLINICAL RELEVANCE/APPLICATION

Our data provide good correlation to DSA follow up supporting MR-MRA as an effective non-invasive method which should be considered for initial follow up.

SSJ19-06

Comparison of Recent Volume of Percutaneous Endovascular Neurointerventions among Radiologists, Neurosurgeons, Neurologists, and Other Physicians: Who is Doing Them?

Mougnyan Cox MD (Presenter): Nothing to Disclose, David C. Levin MD: Consultant, HealthHelp, LLC, Board of Directors, Outpatient Imaging Affiliates, LLC, Laurence Parker PhD: Nothing to Disclose, Vijay Madan Rao MD: Nothing to Disclose

PURPOSE

Historically, cerebral catheter angiography and endovascular neurointerventions (ENI) were developed, refined and practiced by early pioneers in the field of neuroradiology. Recently, rapid developments in the safety and efficacy of ENI have resulted in other physician specialties expressing a strong interest in performing these procedures. Our purpose was to compare trends in performance ENI among the various specialties, as well the overall utilization trends from the years 2000 to 2012.

METHOD AND MATERIALS

Data from the Center for Medicare and Medicaid Services Physician/Supplier Procedure Summary Master Files for 2000 to 2012 were used. The Current Procedural Terminology, 4th edition (CPT) codes for percutaneous neurointerventions were used to obtain the volume of procedures performed in the Medicare fee-for-service population. Using the provider specialty codes, we classified the physicians performing ENI into 6 groups; radiologists, neurosurgeons, neurologists, vascular surgeons, other surgeons, cardiologists and other physicians. The utilization trends for 2000 to 2012 were studied.

RESULTS

Overall, the volume of percutaneous neurointerventions increased from 2439 in 2000 to 7181 in 2012. Radiologists' volume increased from 1956 in 2000 to 3939 in 2012. Neurosurgery ENI volumes increased from 237 in 2000 to 2377 in 2012. Neurology volumes increased from 1 in 2000 to 646 in 2012. Cardiologists' volumes went from no ENI procedures performed in 2000 to 31 in 2012. ENI volumes for vascular surgeons increased from 1 in 2000 to 44 in 2012, and the ENI volumes for all other physicians went from 244 in 2000 to 144 in 2012.

CONCLUSION

Radiologists continue to maintain a strong presence in the field of Neurointerventional radiology, performing 55% of the total number of procedures in 2012, down from 80%. However, neurosurgery has made significant inroads into ENI procedures, with their volume increasing from 10% in 2000 to 33% in 2012. The overall volume of ENI continues to rise at a steady pace from 2000 to 2012.

CLINICAL RELEVANCE/APPLICATION

Radiologists continue to maintain a strong presence in the field of neurointerventional radiology, performing the majority (55%) of percutaneous neurointerventions.

SSJ20

Nuclear Medicine (SPECT/CT and Inflammation Imaging)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00
Tue, Dec 2 3:00 PM - 4:00 PM Location: S505A

Participants

Moderator
Delphine L. Chen MD: Nothing to Disclose
Andrew Quon MD: Nothing to Disclose

Sub-Events
SSJ20-01

**18F-FDG PET: An Independent Prognostic Biomarker in Idiopathic Pulmonary Fibrosis**

**Thida Win**: Nothing to Disclose, **Nicholas J. Screaton BMBCh**: Nothing to Disclose, **Joanna C. Porter PhD, FRCP**: Advisor, Onyx Pharmaceuticals, Inc Advisor, InterMune, Inc, **Balaji Ganeshan PhD** (Presenter): Scientific Director, TexRAD Limited, **Lynn Millner**: Research funded, GlaxoSmithKline plc, **Ashley McAllister Groves MBBS**: Investigator, GlaxoSmithKline plc Investigator, General Electric Company Investigator, Siemens AG

**PURPOSE**

There is a lack of prognostic biomarkers for patients with Idiopathic Pulmonary Fibrosis (IPF). The purpose of this study was to investigate the potential of 18F-FDG PET/CT as a predictor of survival in patients with IPF.

**METHOD AND MATERIALS**

A total of 53 (46 male, 7 female; mean age 76±9.3 years) prospectively and consecutively consented IPF patients were recruited for 18F-FDG PET/CT. Baseline FVC and TLCO were performed. The maximum pulmonary uptake of 18F-FDG (SUVmax), the background lung activity (SUVmin,) and target-to-background ratio (TBR SUVmax/ SUVmin) were quantified. Kaplan-Meier survival analysis assessed the performance of these biomarkers as survival risk classifiers.

**RESULTS**

Mean duration of follow-up was 26.8±18.1-months. There were 17 deaths. FVC (p=0.003), TLCO (p=0.019), SUVmin (p=0.021), TBR (p=0.028) were associated with mortality. Combining SUVmax with both either FVC or TLCO was synergistic (p<0.001 and p<0.011 respectively). Combining TBR with TLCO was also synergistic (p=0.001). Cox Regression showed SUVmin to be an independent survival factor in IPF patients.

**CONCLUSION**

Measurements of pulmonary uptake of 18F-FDG quantified using PET is associated with mortality in patients with IPF.

**CLINICAL RELEVANCE/APPLICATION**

18F-FDG PET/CT has potential to risk stratify patients with IPF.

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SSJ20-02

**Detectability of PET/CT with 68Ga-DOTATOC in Sarcoidosis Patients**

**Tomomi Nobashi** (Presenter): Nothing to Disclose, **Yuji Nakamoto MD, PhD**: Nothing to Disclose, **Takeshi Kubo MD**: Nothing to Disclose, **Koya Nakatani MD, PhD**: Research Grant, Nihon Medi-Physics Co, Ltd, **Sho Koyasu MD**: Nothing to Disclose, **Kaori Togashi MD, PhD**: 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

**PURPOSE**

PET/CT with 68Ga-DOTATOC is known to be useful for detecting neuroendocrine tumors expressing somatostatin receptors. Somatostatin receptors are also expressed on inflammatory cells, but clinical efficacy of DOTATOC-PET/CT (PET/CT) for sarcoidosis has not been fully investigated. The purpose of this study was to compare the detectability of PET/CT for active sarcoidosis, with that of conventional 67Ga-citrate scintigraphy (GS).

**METHOD AND MATERIALS**

A total of 9 patients (M:F=5:4, median age: 66), who were diagnosed as sarcoidosis by biopsy or clinical and radiological criteria, and underwent both GS and PET/CT, were analyzed. A PET/CT scan was performed within a day after GS. In GS, planar for a whole body and available SPECT images were evaluated. All images were interpreted by two experienced nuclear physicians on consensus. For abnormal uptake in both scans, the number of involved areas was counted in evaluating lymph nodes, and the actual number of lesions was counted in evaluating extra-nodal lesions.

**RESULTS**

Overall, detectability was almost comparable between the two modalities in a patient-basis; however, PET/CT showed abnormal uptake in hilar and mediastinal nodes in 8 patients, while GS in 7 patients. A lesion-based analysis, more lesions tended to be depicted by PET/CT. For lymph nodes, the numbers of abnormal uptake in PET/CT and GS were 24 and 18, respectively. For extra-nodal lesions, the numbers of abnormal accumulation on PET/CT and GS were 4 and 2 in uvea, 4 and 0 in muscle, 1 and 1 in lung, and 2 and 2 in submandibular glands, respectively. Of 5 patients who had clinically active uveitis, 2 had diffuse abnormal uptake along eyeballs, which was clearly depicted by PET/CT. Abnormal uptake suggesting cardiac sarcoidosis was not observed in this population. One patient suspicious to have chronic inactive sarcoidosis was negative in both scans.

**CONCLUSION**

PET/CT with 68Ga-DOTATOC depicted more lesions than GS did. Especially, active uveitis was demonstrated clearly by PET/CT.

**CLINICAL RELEVANCE/APPLICATION**

SSJ20-01

**18F-FDG PET: An Independent Prognostic Biomarker in Idiopathic Pulmonary Fibrosis**

**Thida Win**: Nothing to Disclose, **Nicholas J. Screaton BMBCh**: Nothing to Disclose, **Joanna C. Porter PhD, FRCP**: Advisor, Onyx Pharmaceuticals, Inc Advisor, InterMune, Inc, **Balaji Ganeshan PhD** (Presenter): Scientific Director, TexRAD Limited, **Lynn Millner**: Research funded, GlaxoSmithKline plc, **Ashley McAllister Groves MBBS**: Investigator, GlaxoSmithKline plc Investigator, General Electric Company Investigator, Siemens AG

**PURPOSE**

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**METHOD AND MATERIALS**

A total of 53 (46 male, 7 female; mean age 76±9.3 years) prospectively and consecutively consented IPF patients were recruited for 18F-FDG PET/CT. Baseline FVC and TLCO were performed. The maximum pulmonary uptake of 18F-FDG (SUVmax), the background lung activity (SUVmin,) and target-to-background ratio (TBR SUVmax/ SUVmin) were quantified. Kaplan-Meier survival analysis assessed the performance of these biomarkers as survival risk classifiers.

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Mean duration of follow-up was 26.8±18.1-months. There were 17 deaths. FVC (p=0.003), TLCO (p=0.019), SUVmin (p=0.021), TBR (p=0.028) were associated with mortality. Combining SUVmax with both either FVC or TLCO was synergistic (p<0.001 and p<0.011 respectively). Combining TBR with TLCO was also synergistic (p=0.001). Cox Regression showed SUVmin to be an independent survival factor in IPF patients.

**CONCLUSION**

Measurements of pulmonary uptake of 18F-FDG quantified using PET is associated with mortality in patients with IPF.

**CLINICAL RELEVANCE/APPLICATION**

18F-FDG PET/CT has potential to risk stratify patients with IPF.

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**Detectability of PET/CT with 68Ga-DOTATOC in Sarcoidosis Patients**

**Tomomi Nobashi** (Presenter): Nothing to Disclose, **Yuji Nakamoto MD, PhD**: Nothing to Disclose, **Takeshi Kubo MD**: Nothing to Disclose, **Koya Nakatani MD, PhD**: Research Grant, Nihon Medi-Physics Co, Ltd, **Sho Koyasu MD**: Nothing to Disclose, **Kaori Togashi MD, PhD**: 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

**PURPOSE**

PET/CT with 68Ga-DOTATOC is known to be useful for detecting neuroendocrine tumors expressing somatostatin receptors. Somatostatin receptors are also expressed on inflammatory cells, but clinical efficacy of DOTATOC-PET/CT (PET/CT) for sarcoidosis has not been fully investigated. The purpose of this study was to compare the detectability of PET/CT for active sarcoidosis, with that of conventional 67Ga-citrate scintigraphy (GS).

**METHOD AND MATERIALS**

A total of 9 patients (M:F=5:4, median age: 66), who were diagnosed as sarcoidosis by biopsy or clinical and radiological criteria, and underwent both GS and PET/CT, were analyzed. A PET/CT scan was performed within a day after GS. In GS, planar for a whole body and available SPECT images were evaluated. All images were interpreted by two experienced nuclear physicians on consensus. For abnormal uptake in both scans, the number of involved areas was counted in evaluating lymph nodes, and the actual number of lesions was counted in evaluating extra-nodal lesions.

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**CONCLUSION**

PET/CT with 68Ga-DOTATOC depicted more lesions than GS did. Especially, active uveitis was demonstrated clearly by PET/CT.

**CLINICAL RELEVANCE/APPLICATION**
A Retrospective Study to Evaluate the Relationship of CT Findings of Chronic Rhinosinusitis to FDG Uptake on PET/CT

Vevek Parikh (Presenter): Nothing to Disclose, John Edward Buterbaugh MD: Nothing to Disclose, Matthew Covington MD: Nothing to Disclose

PURPOSE
To determine whether there is any evidence of chronic sinus inflammation by correlating FDG uptake with CT findings of chronic sinus disease.

METHOD AND MATERIALS
An IRB-approved retrospective evaluation of 172 consecutive patients receiving whole body positron-emission tomography/computed tomography (PET/CT) examinations from June 2013 through December 2013 was conducted to determine whether there is any evidence of correlation between sinus disease seen on CT and inflammation seen on PET. The images were reviewed using MIM viewing software (MIM Software Inc., Cleveland, OH). The CT exam portions of the PET/CT exams were evaluated for evidence of disease within the paranasal sinuses, specifically in relation to the maxillary, ethmoid, sphenoid and frontal sinuses. Evidence of sinus disease included mucosal thickening, fluid within the sinus, mucosal polyps or retention cysts, mucocele, or any other cause of non-congenital sinus opacification. Sinus disease was graded using the Lund-Mackay staging system. CT findings of chronic sinus disease were then correlated with FDG uptake in the involved sinuses, and maximum standard uptake values (SUV) were recorded at both the region of sinus disease and in the surrounding uninvolved portion of the sinus adjacent to the focus of sinus disease.

RESULTS
Out of 172 patients examined between June and December 2013 undergoing PET/CT examinations, 53 patients were found to have CT evidence of sinus disease. The average FDG activity of the most avid sinus among patients demonstrating CT evidence of sinus disease was an SUV of 1.57. However, when compared to average background activity in the immediately surrounding sinuses, the mean increase in SUV over background of involved sinuses was 0.27. Correlation between SUV max values of the involved sinus and Lund-Mackay staging system scores yielded a Pearson correlation coefficient \( r = 0.31 \), while correlation between SUV sinus over background differences and Lund-Mackay staging system scores yielded an \( r = 0.27 \).

CONCLUSION
There is no correlation between classically described CT findings of chronic sinusitis and inflammation seen on PET/CT. The classically described CT findings of chronic sinusitis may not be a good indicator of chronic inflammation.

CLINICAL RELEVANCE/APPLICATION
Incidental traditional CT findings of chronic sinusitis may not be indicative of chronic inflammation within the sinuses.
CONCLUSION

99mTc-MDP Bone SPECT/CT provides incremental information over two-phase planar bone scan in identifying pain generators post-hip arthroplasty. 99mTc-MDP Bone SPECT/CT increases the diagnostic confidence to make a reliable diagnosis and direct further management.

CLINICAL RELEVANCE/APPLICATION

99mTc-MDP Bone SPECT/CT provides incremental information and improved diagnostic confidence over conventional two-phase planar bone scan in identifying the aetiology of pain post-hip arthroplasty.

SSJ20-05

Performance of SPECT/CT Compared to Planar Bone Scintigraphy in the Assessment of Microvascular Bone Grafts in Mandible Reconstruction

Matthieu J. Ouvrier MD (Presenter): Nothing to Disclose, Colette Zwarthoed MD: Nothing to Disclose, Danielle Benisvy: Nothing to Disclose, Jose Benoliel PhD: Nothing to Disclose, Olivier Dassonville MD: Nothing to Disclose, Jacques Darcourt MD, PhD: Nothing to Disclose

PURPOSE

The aim of this study was to compare the performance of planar bone scintigraphy (BS) and SPECT/CT in the assessment of microvascular bone grafts in mandible reconstruction 24 hours after surgery.

METHOD AND MATERIALS

Twelve mandible reconstructions were performed on 11 patients (8M/3F, 56 ± 13 y/o), 9 with cancer (squamous cell carcinoma n=5, adenoid cystic carcinoma n=3, rhabdomyosarcoma n=1) and 2 with osteoradionecrosis. Reconstruction of the mandible consisted of an autogenous microvascular bone grafting with a fibular free-flap with a skin pedicle. Fourteen planar BS and SPECT/CT were performed 24 hours after surgery. Patients were injected with 99mTc-HMDP (10MBq/kg). BS were acquired on a Siemens Symbia T2 240 minutes after injection, systematically followed by a SPECT/CT. Images were reconstructed in 3-mm slices every 2 mm. SPECT images were reconstructed using CT for attenuation correction and using iterative reconstruction. Planar and SPECT/CT BS were analyzed semi-qualitatively by two nuclear physicians. Consensus was found between the two physicians when there was a discrepancy. They were rated as certainly not viable, probably not viable, equivocal, probably viable, certainly viable. Follow-up was used as gold standard.

RESULTS

Seven patients were free of complications, 2 had partial muscular necrosis, 1 had infectious complication but no necrosis and 1 had bone necrosis on 2 different free-flaps. Two planar BS were rated as certainly not viable, 1 probably not viable, 2 equivocal, 3 probably viable and 6 certainly viable. Three SPECT/CT were rated as probably not viable, none were rated as probably not viable nor equivocal, 4 were rated as probably viable and 7 as certainly viable. For planar BS and SPECT/CT, sensitivity was respectively 82% and 100%. Specificity was 100% for both. The level of confidence did not significantly improve but there was less indeterminate ratings with SPECT/CT than with planar BS (4 vs 6).

CONCLUSION

SPECT/CT could be a better tool 24 hours after surgery, when patients are not necessarily stable, for assessing microvascular bone grafts in mandible reconstruction, thus reducing the time of presence in the department.

CLINICAL RELEVANCE/APPLICATION

SPECT/CT has better performance than planar BS in the assessment of microvascular bone grafts in mandible reconstruction 24 hours after surgery, when patients are not necessarily stable.

SSJ20-06

Evaluating the Role of Attenuation Correction in Ventilation/Perfusion SPECT for Analysis and 3D Quantification of Lung Function


PURPOSE

The established analysis and quantification of lung function in 2 dimensions (D) is increasingly replaced by a 3D approach. Purpose of this study was to evaluate the influence of attenuation correction (AC) on the 3D analysis and quantification of ventilation/perfusion (V/P) SPECT

METHOD AND MATERIALS

21 patients with inhomogeneous pulmonary ventilation and perfusion pattern due to pulmonary emphysema (PE) were scanned with V/P SPECT/CT (Tracer: Tc-99m Technegas and Tc-99m-MAA). The data was analyzed
with a software based analysis system (RunPMOD 3.4). Counts per lung lobe (CpLo) were assessed for AC SPECT and non-AC SPECT. Percentages of counts (PC=(CpLo/CpLu)*100) were calculated. Two physicians for nuclear medicine performed a visual consensus comparison of AC and non-AC SPECT with a 5 point scale (1=low conformity; 5= high conformity). The association between AC and non-AC SPECT was analyzed using Spearman's Rho correlation coefficient. Differences between AC and non-AC SPECT were tested with the t-test for significance.

RESULTS

The correlation coefficients for P SPECT were: 0.511 (p<0.001) for CpLo; and 0.982 (p<0.001 for PC). The mean difference between PC was 1.31%±1.11% with the highest difference (1.56%±1.99%) in the right lower lobe. Resulting p-values in the t-test were: p = 0.889 for PC; and p<0.001 for count CpLo. The correlation coefficients for V SPECT were: 0.515 (p<0.001) for CpLo; and 0.979 (p<0.001 for PC). The mean difference between PC was 1.48%±1.19% with the highest difference (1.62%±1.77%) in the right middle lobe. Resulting p-values in the t-test were: p = 0.809 for PC; and p<0.001 for CpLo. All AC and non-AC SPECT were rated as highly conform in the visual analysis.

CONCLUSION

AC and non-AC SPECT have a high correlation regarding the proportions of lobe based ventilation and perfusion. Analysis and exact quantification of lung function can be performed with non-AC SPECT.

CLINICAL RELEVANCE/APPLICATION

If separate high-resolution chest CT images are available SPECT suffices and SPECT/CT is not necessary when analyzing and quantifying lung function in 3D.

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**Physics (Radiation Therapy II)**

Scientific Papers

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

Tue, Dec 2 3:00 PM - 4:00 PM  Location: S403A

Participants

Moderator
Lei Xing PhD : Research Grant, Varian Medical Systems, Inc
Moderator
Cem Altunbas PhD : Nothing to Disclose

Sub-Events

**SSJ21-01 Is there a Threshold Limit in the Accuracy of Deformable Image Registration (DIR)? A Validation Study Using Deformable Bladder Phantom with Implanted Markers**

Raj Varadhan PhD (Presenter): Nothing to Disclose, Susanta K. Hui PhD: Nothing to Disclose

**PURPOSE**

To establish the fundamental relationship between deformation and its causative physical force using a deformable bladder phantom. To ascertain if a threshold limit exists for DIR accuracy, beyond which its applicability in deformed anatomy may be clinically inappropriate.

**METHOD AND MATERIALS**

A tissue equivalent deformable bladder phantom with 21 implanted aluminum markers was developed using a viscoelastic polymer with Young's modulus and physical density properties comparable to human bladder. Applied force on the organ was incrementally varied from 10N to 70N which in turn deforms the organ. DIR accuracy was studied for commercially available algorithms (MIM and Velocity AI) by comparing the centroid (3D vector) of the 21 marker locations at the undeformed CT (ground truth) with the synthetically derived marker positions from each target image obtained from DIR

**RESULTS**

The relationship between applied force and both 1D deformation along the axis of applied force (R2 =0.99) and 3D deformation as quantified by the 95% hausdorff distance (R2 =0.96) showed a linear response. The maximum 1D deformation (compression) ranged from 3mm to 28 mm. A threshold limit at 30N (maximum13mm 1D and 6.8 mm 3D deformation) was established beyond which average registration error of 21 markers was ≥ 2mm for all algorithms studied. Utilizing the "Reg Reveal" feature of the MIM software, the marker accuracy beyond 50N improved by 2mm while the average marker error using Velocity multipass deformation was ≤3mm up to 50N.

**CONCLUSION**

The accuracy of DIR was evaluated using a tissue equivalent mass and density conserving bladder phantom in the best case scenario using 21 implanted aluminum high contrast markers to improve the accuracy. The limits
SSJ21-02  Use of Optimal Respiratory Gating with Continuous Bed Motion PET/CT to Improve Personalized Radiation Therapy Planning

Dustin Osborne : Nothing to Disclose, Shelley Acuff ARRT (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The purpose of this work is to assess the potential of advanced amplitude-based gating techniques with continuous bed motion PET/CT to improve the use of dose painting in regions where there exists a high probability for motion artifacts. The hypothesis is that advanced amplitude-based gating techniques used in conjunction with continuous bed motion PET/CT imaging will enable increased visibility of lesion topography that may indicate regions that should benefit from simultaneous treatment during radiotherapy. This study uses an amplitude-based gating method known as optimal respiratory gating that examines the respiratory cycle and chooses data points where the least amount of motion was observed during the scan time.

Materials/Methods: A patient with suspected lung cancer was imaged for initial staging using PET/CT. The patient was fitted with a standard respiratory belt for recording the respiratory cycle during the imaging sequence. Following the scan, data were processed as a standard PET/CT image and using optimal respiratory gating. Both image sets were sent to radiation therapy planning software for assessment and for drawing of dose contours. Countours were drawn for both the standard PET/CT images as well as the images created using optimal respiratory gating.

Results: Images reviewed using standard PET/CT indicated a large lesion with a small necrotic core of dimensions 2.4 cm x 1.1 cm x 1.3 cm. This necrotic center was not large enough to draw accurate contours or warrant additional review for customized radiation therapy planning and so the entire tumor volume would have been treated to 100% dose. The images processed using optimal respiratory gating showed a significant increase in the size of the necrotic core measuring 2.6 cm x 2.7 cm x 2.4 cm. This indicated a dramatic increase of over 4x the measured volume of the necrotic core using standard PET/CT. This increase in the size of the necrotic area of the lesion enabled accurate contouring of the area so that a customized dose plan could be applied to the motion affected region. For contoured regions inside the designated necrotic area, delivered dose was increased to 130%. Data showing the change in image quality and contoured regions will be shown.

Conclusion: Use of optimal respiratory gating enables improved image quality by significantly reducing the impact of motion on PET/CT images. These techniques enable visualization of motion-free imaging that may lead to improved use of dose painting techniques in areas of significant motion and subsequently improved patient outcomes.

SSJ21-03  Development of Hydraulic Lung Phantom for 4-dimensional Computed Tomography

Ja Choon Koo (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Recently the radiation therapy device that is tracking pulmonary tumors according to respiratory cycle is developed to minimize the dose to normal tissues such as 4D-CT and IMRT (Intensity modulated radiotherapy). Accordingly, 4-Dimensional Phantom mimicked the human lung should be developed in order to measure the accuracy of new radiation therapy device. Existing 4d-phantom is limited to represent patient's lung motion and used metal materials. So Metal Artifact that debase CT image resolution exist. To improve this situation, we created the Hydraulic Lung Phantom that the volume change is large and the deformation is dynamical.

Materials/Methods: The constitution of the Hydraulic Lung Phantom is that the piston serves as diaphragm for precise control and the piston and cylinder surrounding the lung model consist of a non-metallic material. Using the cylinder pressure, the whole of lung model is pressurized or gradually increase the entire deformation and have gradient deformation. Sponges with different sizes of plaid is placed inside the lung model. The density of lung model is constant but the deformation of each part is not constant. Results: When the volume change and motion of actual patient’s lung is compared with Hydraulic Lung Phantom, the volume change of lung show 25~30% and deformation has partially gradient. Also the Hydraulic Lung Phantom is not consist of metallic material. So CT-image resolution is sharp and clear without Metal Artifact. Besides constituents of lung is homogeneous at the same time as the deformation is 3-dimensional to axial direction as well as radius direction more than 2-cm. Using sponge with plaid CT-number is similar to actual patient’s lung. And using algorithm made by a program software the system is built to match the patient’s respiratory cycle.

Conclusions: In this study, the Hydraulic Lung Phantom is developed to complement existing 4d-phantom. Not getting the trust from the actuator directly but from hydraulic pressure, the volume change is more than 25%. Also using the non-metallic material CT-image resolution is clear and using software program the Hydraulic Lung Phantom mimic various lung motion. Lastly to present homogeneous lung density and have gradient deformation Sponges with different sizes of plaid is placed inside the lung model.

SSJ21-04  Automatic Feature-based Co-Registration of Digitally Reconstructed Radiography (DRR) and kv Setup Images

Xin Wang PhD (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Two-dimensional (2D) to 2D matching of the kv setup and digitally reconstructed radiography (DRR) images is a popular patient setup technique for image-guided radiotherapy (IGRT). Mutual information based methods were developed to co-register these two types of images on commercial linear accelerators[1]. However, additional operator involvement is
would offer many advantages, including improved integration and utilization of complementary imaging technologies. Integration of a kV x-ray source into the treatment head of a modern radiotherapy accelerator would facilitate real-time monitoring of the treatment process.

**Purpose**

Disclose

El-Mohri PhD: Nothing to Disclose
Larry Edward Antonuk PhD (Presenter): Nothing to Disclose

Gamma-Camera for Image-guided Low-energy Breast Brachytherapy

Anastasia Mishchenko MSc (Presenter): Institutional research collaboration, Analogic Corporation, Olivier Tousignant PhD: Employee, Analogic Corporation, Aram Teymurazyan PhD: Research collaboration, Analogic Corporation, Ananth Ravi PhD: Nothing to Disclose, Alla Reznik PhD: Research partner, Analogic Canada Corporation Research partner, Koninklijke Philips NV

**Conclusion**

Implementation of our gamma-camera for PBSI has the potential to significantly improve the accuracy of radioactive seeds implantation, which may increase the adoption of the procedure thereby potentially improving breast cancer patients quality of life.

**Background**

Permanent Breast Seed Implantation (PBSI) is an innovative method of accelerated partial breast irradiation for post-operative treatment of early breast cancer. It has the potential to improve the quality of life of breast cancer patients as it avoids protracted radiation treatments and acute skin reaction. The technique involves the permanent implantation of 80-90 small 103-Palladium radioactive seeds into the breast (PBSI) at the lumpectomy cavity to deliver precisely calculated radiation doses to the target volume with a safety margin. To date more than 150 patients were accrued into clinical trials with favorable outcomes. However, the implementation of PBSI into widespread routine practice would greatly benefit from a development of a dedicated device that guides seed implantation and evaluates the dose distribution during and at the end of the implantation. Here we evaluate the ability to localize radioactive seeds with a novel dedicated gamma-camera prototype vs. clinical requirements.

**Evaluation**

Imaging performance has been evaluated with realistic breast phantoms mimicking dense breast tissue and fatty breast tissue, and simulated PBSI procedure. The breast phantom thickness was varied from 1 to 6 cm and from 1 to 5 brachytherapy sources were separated by 0.5, 1, 2 cm. In order to quantify the camera response, the breast phantom with implanted seeds was placed in front of collimator face. All seeds at all separations and depths are clearly distinguishable visually. The profiles of the seeds in the images were fit with a Gaussian distribution in both phantoms, from which the positions of the sources were derived.

**Discussion**

The requirements of the prototype system is that it will be able to distinguish seeds placed 5mm and greater from each other within a imaging time window of 2 min. Our studies show that the evaluated gamma-camera has adequate spatial resolution and sensitivity, which fulfills these clinical requirements.

**Theoretical Investigation of the Design and Performance of Dual Energy X-ray Detectors for KV and MV CBCT Imaging in a Radiotherapy Treatment Room**

Larry Edward Antonuk PhD (Presenter): Nothing to Disclose, Langchuan Liu : Nothing to Disclose, Youcef El-Mohri PhD : Nothing to Disclose, Hao Jiang : Nothing to Disclose, Qihua Zhao PhD : Nothing to Disclose

**Purpose**

Integration of a kV x-ray source into the treatment head of a modern radiotherapy accelerator would facilitate geometric fusion of the CBCT images acquired using the MV treatment beam and the kV source. Such capability would offer many advantages, including improved integration and utilization of complementary imaging...
information as well as reduced hardware and maintenance. However, effective exploitation of this possibility would require x-ray detectors configured to provide high-DQE performance at MV energies, while preserving contrast, noise and spatial resolution at kV energies. A theoretical examination of the performance considerations governing the design of such detectors, based on matrices of optically isolated segmented scintillating BGO crystals coupled to active matrix flat-panel imaging arrays, is presented.

METHOD AND MATERIALS

Imaging performance of detector designs with scintillator thicknesses ranging from 0.25 to 2.0 cm and pitches ranging from 0.508 to 1.016 mm was examined. The calculations employed a hybrid Monte Carlo modeling technique based on radiation transport simulation coupled to optical Swank noise and blur determination. For each design, MTF and CNR for scintillator-array configurations involving front and back illumination were determined at 100 kVp and 6 MV.

RESULTS

Compared to conventional front illumination, back illumination provides very similar radiation transport results, but greatly reduced optical blur and Swank noise. With back illumination and a black reflector, CNR and MTF kV imaging performance is found to be largely insensitive to segmented scintillator thickness, permitting greater material thickness for MV x-ray detection. As thickness increases (and depending upon the pitch), while MV MTF decreases by ~45% to 50%, MV CNR increases by a factor ranging from ~2.7 to 2.8.

CONCLUSION

These initial results suggest the possibility of achieving dual energy x-ray imagers that exhibit CNR performance close to that of conventional treatment-room diagnostic imagers, while also providing over an order of magnitude improvement in CNR compared to that of existing megavoltage radiotherapy imagers.

CLINICAL RELEVANCE/APPLICATION

kV and MV image acquisition with a dual-energy detector and a kV source aligned with the treatment beam would precisely align volumetric information and facilitate improved precision in beam delivery.
RESULTS
The sensitivities of our automated detection systems were 78.0% at 6 false positives/volume (FP/vol.) (86.1% at 10 FP/vol.) and 73.1% at 6 FP/vol. (87.2% at 10 FP/vol.) for the mediastinal and abdominal datasets respectively. Approximately 20% of the false positives were actually small lymph nodes (<10 mm).

CONCLUSION
We validated a novel approach to automated lymph node detection in CT images that significantly outperforms the previous best reported work.

CLINICAL RELEVANCE/APPLICATION
Detection of lymphadenopathy is crucial in cancer patients to assess staging and treatment response. Automated detection may permit more accurate and time efficient assessment.

SSJ22-02
Lauren M. Kim MD (Presenter): Nothing to Disclose, Holger Reinhard Roth PhD: Nothing to Disclose, Le Lu PhD: Nothing to Disclose, Kevin Cherry: Nothing to Disclose, Shijun Wang: Nothing to Disclose, Evrim Bengi Turkbey MD: Nothing to Disclose, Ronald M. Summers MD, PhD: Royalties, iCAD, Inc Research funded, iCAD, Inc Stockholder, Johnson & Johnson Grant, Viatronix, Inc

PURPOSE
To assess the performance of a retroperitoneal lymph node (LN) computer-assisted detection (CADe) system using a novel employing Random Forest (RF) and Convolutional Neural Network (CNN) machine learning classifiers in tandem.

METHOD AND MATERIALS
One radiologist, serving as the standard of ground truth, labeled 595 abdominal LN (>1cm in the short axis) on 86 CT examinations which were assorted into training (60/86), cross-validation (12/86), and test (14/86) sets. CADe was comprised of a two-phased approach, the first consisting of retroperitoneal LN candidate generation by a RF classifier which generated 40 false positives (FP) per patient at maximum sensitivity. Subsequently a CNN classifier using 100 observers was trained at 100% sensitivity with FP detections of the RF classifier used as training examples of true negatives. Subsequently, the CADe was set at an operating point to display marks with confidences of at least 0.5. These CADe marks were appraised by an independent, unbiased radiologist who reviewed the 14 CT examinations in the test set and identified each identified retroperitoneal LN as undetected by CADe [false negative (FN)], CADe true positive (TP) representing a LN >8mm in the short axis, or CADe FP.

RESULTS
In an independent analysis by a radiologist, CADe sensitivity on the test set was 83% generating on average 2 FP per patient. No physical feature was definitively determined to elevate the FP rate except the presence of ascites (Chi-square test, p<0.05) which elevated the FP rate approximately 4-fold.

CONCLUSION
This retroperitoneal LN CADe is highly sensitive at a low FP rate. Ascites confounds this CADe system, substantially and significantly elevating its FP rate.

CLINICAL RELEVANCE/APPLICATION
The accurate detection of lymph nodes plays a critical role in the diagnosis, staging, and subsequent management of neoplastic malignancy though is an inherently difficult task given their variable size, appearance, and location. Here we present a retroperitoneal LN CADe employing two machine learning algorithms in tandem which substantially outperforms previous state-of-the-art techniques which are reported to generate 3-6 FP per volume of interest (VOI) at sensitivities ranging from 53-61%. With further validation and refinement, our LN CADe may substantially bolster a radiologist’s sensitivity and proficiency in the assessment of lymph nodes.

SSJ22-03
Use of Random Forest in a Novel Dynamic Random Conditional Field-based Computer-aided Diagnosis System for Prostate Cancer Segmentation and Labeling on Multi-Parametric MR Images

PURPOSE
We demonstrate a novel automated prostate computer-aided diagnosis (CADx) system utilizing random forest.
We demonstrate an automated, supervised prostate computer-aided diagnosis (CADx) system utilizing a novel algorithm based on dynamic conditional random fields (DCRF) and evaluate the performance of this system with and without the use of a random forest (RF).

**METHOD AND MATERIALS**

Multi-parametric 3T prostate MRI scans were performed on 60 patients using an endorectal coil. Pathology was established using MRI-TRUS fusion biopsies. Cancer and central gland segmentations were established by a trained radiologist for 40 training and 20 test cases on T2 weighted images (T2WI). ADC images and Ktrans maps (from DCE images) were registered to the T2 images using coordinate information. Features included intensities of T2WI, ADC, and Ktrans images, location information, and entropy of 3D sub-volume extracted around each node. A dynamic conditional random field with one layer of observations and two hidden layers was utilized to label and segment prostate lesions. The hidden variables defined whether a voxel was located in the central gland or in the peripheral zone, and whether it represented cancer. The DCRF classifier was trained using pseudo-negative log likelihood. A cascading classifier system was tested with an RF feeding into the DCRF. Prediction maps were generated by applying the classifier to test images. Statistical analysis of receiver operating characteristic (ROC) curves were conducted using the Mann-Whitney U Test.

**RESULTS**

The proposed DCRF method without RF yielded an AUC of 0.8432 (95% C.I. [0.8422, 0.8441]) for classifying prostate lesions, compared to an AUC of 0.8889 (95% C.I. [0.8881, 0.8897]) using the DCRF with RF. DCRF with RF was found to have a statistically superior AUC compared to DCRF alone (p<0.01). Prediction maps and ROC curves are shown in Figure 1.

**CONCLUSION**

Random forest increases the performance of the proposed DCRF method in classifying cancer on multi-parametric prostate MRI. Clinically useful prediction maps may be generated using the proposed methods.

**CLINICAL RELEVANCE/APPLICATION**

An improved CADx system may reduce reading time, increase the performance of less expert readers, and decrease inter-observer variability in interpreting prostate MR images.

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**Robust Computer-aided Detection of Tuberculosis in Chest Radiographs Using Energy Normalization**

Rick Philipsen MSc (Presenter): Nothing to Disclose, Pragnya Maduskar BEng, MENG: Nothing to Disclose, Laurens Hogeweg: Nothing to Disclose, Jaime Melendez: Nothing to Disclose, Clara Isabel Sanchez MSc, PhD: Nothing to Disclose, 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**

The performance of computer-aided detection (CAD) algorithms for chest radiography can be influenced by variations in image data coming from different sources. Acquisition settings, detector technology and proprietary post-processing all influence the appearance of radiographs. We developed an algorithm to standardize the appearance of chest radiographs (CXRs) in order to remove these variations prior to image analysis and evaluated its utility for a CAD system aimed at tuberculosis (TB) detection.

**METHOD AND MATERIALS**

Three data sets of 200 digital CXRs were used: 100 normal / 100 abnormal cases from an Odelca DR system acquired in Zambia; 127 normal / 73 abnormal cases from a Philips Digital Diagnost system acquired in the United Kingdom. Reference standard for suspicion of TB was set by an expert reader. To standardize the appearance of CXRs, the image is decomposed into frequency bands using hierarchical unsharp masking. In a training set the average energy (standard deviation) of each frequency band in the central part of the image is determined. Each energy band is scaled to this reference energy, and the input image is reconstructed from the scaled frequency bands. Subsequently the lung fields and mediastinum are segmented via pixel classification and the energy normalization is repeated for region containing the union of lung fields and mediastinum. Cases were processed by a CAD system (CAD4TB v3.07, Diagnostic Image Analysis Group, Nijmegen, The Netherlands) with and without applying the energy normalization method. This CAD system was trained with cases from an Odelca DR system. Performance was measured as area under the ROC curve (Az). Pairwise comparisons were made with bootstrap estimation, considering p<0.05 significant.

**RESULTS**

Without normalization, CAD4TB obtained an Az of 0.80, 0.61 and 0.47 for the data from Zambia, The Gambia, and the United Kingdom, respectively. With normalization, Az increased to 0.87, 0.80 and 0.84. Differences for the data from The Gambia and the United Kingdom were significant.

**CONCLUSION**

The robustness of CAD for detection of signs of TB on CXRs is improved by standardizing the radiographs prior to analysis.

**CLINICAL RELEVANCE/APPLICATION**

An automated reading system for CXRs that can be used reliably on data from any digital unit has great potential in TB screening and active case finding.
SSJ22-05

Computer-aided Detection of Prostate Cancer in Multi-parametric Magnetic Resonance Imaging

Geert Litjens MSc : Nothing to Disclose , Nico Karssenmeijer PhD : Shareholder, Matakina International Limited Scientific Board , Matakina International Limited Shareholder, QView Medical, Inc Research Grant, Riverain Technologies, LLC , Jelle O. Barentsz MD, PhD : Nothing to Disclose , Henkjan Huisman PhD (Presenter): Stockholder, QView Medical, Inc

PURPOSE

Accurate reporting of multi-parametric prostate magnetic resonance imaging (mpMRI) is difficult and requires substantial experience. We investigate the effect of computer-aided diagnosis (CAD) on the diagnostic accuracy of prostate MRI reporting.

METHOD AND MATERIALS

Two consecutive cohorts of patients were used. One for training/development of the CAD system (347 patients) and one for the prospective evaluation (130 patients). Both cohorts comprised mpMRI and subsequent MR-guided biopsy and pathology. The mpMRIs were ESUR guideline compliant and performed on a Siemens 3T MRI without the use of an endo-rectal coil. Both cohorts were prospectively reported by one of ten radiologists according to the PI-RADS guidelines. Experience of the radiologists ranged from inexperienced (1-20 years). The computer-aided diagnosis (CAD) system comprised of a voxel classification stage and a subsequent candidate segmentation and classification stage. Features include quantified T2, ADC, pharmacokinetics, texture and anatomical characteristics. ROC and FROC analysis was used to evaluate performance. For the prospective validation the CAD system assigned a score to each radiologist-identified lesion. Logistic regression combining the radiologist and CAD scores was used to emulate independent, prospective CAD reading. Subsequently, the diagnostic performance in detecting intermediate-to-high-grade cancer of the CAD system alone, the radiologist alone and the radiologist-CAD-system combination was evaluated using sensitivity and specificity for the different PI-RADS thresholds. Bootstrapping was used to assess significance.

RESULTS

FROC analyses showed that the CAD system could detect 82% of all intermediate-to-high-grade lesions at 1 false positive per case. Combined CAD and radiologist score significantly improved the sensitivity at a PI-RADS 4 threshold over the radiologist alone (0.98 for the combination, 0.93 for the radiologist alone, p = 0.029). A significantly improved specificity was found at a PI-RADS threshold of 3 (0.25 versus 0.09, p = 0.013).

CONCLUSION

CAD can achieve excellent performance. As a second observer to characterize prostate lesions it can improve sensitivity and specificity in discriminating intermediate-to-high-grade cancer.

CLINICAL RELEVANCE/APPLICATION

Improving the performance of mpMRI in the detection of prostate cancer by CAD can prevent unnecessary biopsies.

SSJ22-06

Digital Breast Tomosynthesis: Joint Reconstruction and Planar Projection Framework for Computer Aided Detection of Clustered Microcalcifications

Ravi Kumar Samala PhD (Presenter): Nothing to Disclose , Heang-Ping Chan PhD : Institutional research collaboration, General Electric Company , Yao Lu PhD : Nothing to Disclose , Lubomir M. Hadjiiski PhD : Nothing to Disclose , Jun Wei PhD : Nothing to Disclose , Mark Alan Helvie MD : Institutional Grant, General Electric Company

PURPOSE

To develop a framework utilizing the reconstructed volume and planar projection (PPJ) image of digital breast tomosynthesis (DBT) for computer aided detection (CADe) of microcalcification clusters (MCs).

METHOD AND MATERIALS

With IRB approval and informed consent, DBTs of 154 subjects (307 views) were acquired with a GE prototype system at 21 projections, 3° increments, over a 60° arc. DBT with 30° arc was reconstructed using the central 11 projections to simulate narrow-angle DBT system. SART with multiscale bilateral regularization that we developed to enhance calcifications and suppress noise was used to generate DBT volume and PPJ image. 127 views with MCs were used for training and 104 views with and 76 views without MCs were used for independent testing. Multiscale calcification response (MCR) was derived from the DBT volume. Calcification candidates were extracted by iterative region growing and thresholding of PPJ image, a subset of which with high contrast-to-noise ratio (CNR) and MCR were identified as cluster centroid objects. The CNR threshold tC and decision rules for classification of true positives (TPs) and false positives (FPs) were determined adaptively based on the statistical properties of the CNR histogram for a given view. Starting from cluster centroid objects, conditional dynamic clustering forms clusters based on tC and radial distance while continuously adjusting size and centroid position. A convolution neural network (CNN) was trained to classify TPs from tissue structures and artifacts on the PPJ image. FP clusters were further reduced by the CNN response, cluster shape and combination of size, CNR and number of candidates in a cluster. The performance of the joint DBT-PPJ framework was compared to the individual CADe in DBT and PPJ using JAFROC analysis.

RESULTS

At view-based test sensitivities of 80 and 85%, the joint CADe resulted in 0.92 and 3.02 FPs/view. The
individual DBT and PPJ CADe achieved a maximum sensitivity of 71% (3.03 FPs/view) and 79% (2.42 FPs/view). JAFROC analysis showed a significant improvement of joint CADe compared to DBT ($p<0.0001$) and PPJ ($p=0.0022$).

**CONCLUSION**

Joint DBT-PPJ CADe for MCs outperforms individual CADe in DBT and PPJ.

**CLINICAL RELEVANCE/APPLICATION**

The joint DBT-PPJ framework improves the performance of the CADe system for MCs, further improving its potential as an adjunct in radiologist’s workflow for interpretation of DBT.
RESULTS

The attached figure depicts four phase cycle (Δθ = 0°, 90°, 180°, and 270°) axial magnitude images of the temporal bone (a-d) and foramen magnum (e-j), and the corresponding CS (e and k) and GS (f and l). The original phase cycle bSSFP images demonstrate banding, spuriously bright signal regions, and periodic motion artifact along the phase encoding direction stemming from globe motion, CSF pulsation, and carotid arterial flow. Colored arrows in the CS show residual banding in the globes (green) and CSF (yellow), erroneous contrast in the nasopharynx and prevertebral space (blue), and residual vascular and CSF flow artifact (red). Equivalently colored arrows in the GS indicate that nearly all artifacts are eliminated relative to the CS.

CONCLUSION

The GS removes the dependence of bSSFP signal on field inhomogeneity in the temporal bone and adjacent structures; unlike the CS, it yields reliable contrast without banding. The GS further achieves high noise immunity, typified by its insensitivity to motion-ghosting artifacts present in the original phase cycle images.

CLINICAL RELEVANCE/APPLICATION

A novel geometric solution eliminates banding due to field inhomogeneity and reduces motion artifacts due to arterial/CSF pulsation in balanced steady state free precession MRI of the temporal bone.
CONCLUSION
We have investigated T1 relaxation time after IRE procedure pre- and post-contrast in porcine liver and have shown optimized T1w MRI can accurately depict IRE ablation zone size using histopathologic correlation.

CLINICAL RELEVANCE/APPLICATION
IRE is a new technique for minimally invasive and non-thermal tissue ablation, and our study can be used to optimally create T1 contrast to depict IRE ablation zones.

SSJ23-04
Pia M. Jungmann MD (Presenter): Nothing to Disclose, Christoph Schaeffeler MD: Nothing to Disclose, Reinhard Meier MD, PhD: Nothing to Disclose, Carl Ganter Msc, PhD: Nothing to Disclose, Ernst J. Rummery MD: Nothing to Disclose

PURPOSE
To compare WARP metal artifact-reducing techniques, that combine slice-encoding metal artifact correction (SEMAC), view-angle tilting (VAT) and increased bandwidth with conventional metal artifact-reducing MR sequences in the assessment of periprosthetic soft tissue abnormalities.

METHOD AND MATERIALS
Twenty-five patients (13 male, 12 female) with metal implants (n=30), referred for MR imaging to evaluate tumor-recurrence or periprosthetic infection, were included. At 1.5T, WARP-techniques and conventional metal artifact-reducing MR sequences (standard-group) were compared for two pulse sequences: Coronal short-tau-inversion-recovery (STIR; n=19 patients) and coronal contrast enhanced T1-weighted (w) sequences (n=19 patients). Quantitative artifact diameters were measured by two experienced radiologists in consensus at four randomly selected spots for each implant. Qualitative parameters were assessed on a five-point scale (1=best, 5=worst): “image distortion”, “artificial signal changes at the edges”, and “diagnostic confidence”. T-tests (quantitative assessment) and Wilcoxon-signed rank tests (qualitative assessment) were used for statistical analyses.

RESULTS
Implants were located at the upper extremity (4/30; humerus or radius), at the lumbar spine (4/30) or at the lower extremity (22/30; proximal femur, knee or tibia). In 3 cases, tumor-recurrence, in 7 cases infection and in 12 cases other pathologies were diagnosed (Figure). Artifacts were significantly reduced in the WARP-group as compared with the standard-group. For STIR images, the mean difference of artifact diameters (+SD) was 10.2±1.6mm (P<0.001; T1-w, 4.1±0.6mm, P<0.001). On images with WARP-techniques, ‘distortion’ and ‘artificial signal changes’ were reduced (STIR, P=0.021, P=0.060; T1-w, P<0.001, P<0.001) and ‘diagnostic confidence’ improved (STIR, 2.1±0.9 vs 3.5±1.9, P=0.002; T1-w, 1.4±0.7 vs 2.8±1.2, P=0.001).

CONCLUSION
Significant reduction of through-plane and in-plane artifacts was achieved by application of WARP-techniques. These new techniques improved diagnostic image-quality and may be beneficial for detecting periprosthetic pathologies during postoperative follow-up.

CLINICAL RELEVANCE/APPLICATION
New WARP-techniques appear applicable for postoperative follow-up MR imaging of patients with metal implants and suspicion of periprosthetic infection or tumor recurrence.

SSJ23-05
Jiming Zhang PhD: Nothing to Disclose, Amol Pednekar PhD: Employee, Koninklijke Philips NV, Pei-Herng Hor PhD: Nothing to Disclose, Raja Muthupillai PhD (Presenter): Research support, Koninklijke Philips NV

PURPOSE
In MR-ARFI, tissue displacement at the high-intensity ultrasound focus sets off a shear wave, and displacement within tissue is measured using motion encoding gradients (MEG). We propose a Radon transform (RT) based method to estimate shear wave propagation speed in a homogenous medium.

METHOD AND MATERIALS
MR-ARFI sequence was implemented on a commercial 1.5 T platform (Sonalleve™, Philips). A phase contrast sequence was modified to include a symmetric bipolar MEG (4 ms duration @ 27mT/m) to encode tissue displacement in the plane bisecting HIFU focus (Fig.2). By progressively increasing the time delay (τ) between HIFU discharge and MEG, shear wave propagation was captured as a series of snapshots. Data Analysis: After background phase correction, two successive RT converted the displacement map I(x,y) to Radon space J(ρ,θ) with two distinct peaks at θ=0 (Fig.3). Shear wave speed was calculated from τ and the distance (d) between the two peaks (d=distance travelled by the wave from the HIFU focus) using d/τ.
RESULTS

A snapshot of the propagating shear wave is shown in Fig. 3 (left). Projection onto the J(r,Θ) space converts the circularly symmetric wavefront into a parallel lines which is further condensed to two points upon subsequent RT. The SNR computed for the wavefront region using zero phase noise was 2.3 in I(x,y), which increased to 6.0 in J(r,Θ) and was boosted to 25.5 after second Radon transform. Shear wave velocity (v) was calculated as 4.01±0.06m/s from a series of images at progressively increasing τ(Fig.4). The estimated effective shear stiffness was then calculated as μ = ρv^2 = 16.4±0.5kPa with known phantom density of 1020kg•m⁻³.

CONCLUSION

An unsupervised RT based method with very high displacement SNR can be used to estimate shear wave speed in homogeneous media. It should be noted that unlike single-frequency MRE, MR-ARFI methods estimate the group velocity of shear wave propagation.

CLINICAL RELEVANCE/APPLICATION

We describe a gradient echo based technique suitable for magnetic resonance acoustic radiation force imaging (MR-ARFI) and the validation of the method in a gel phantom. The propagation of the displacement wave emanating from the ultrasound focus within the phantom material was clearly captured by the method. We also describe a radon transform based method to reliably reconstruct the mechanical properties of homogeneous phantom material from MR-ARFI.

SSJ23-06 3D FSE Imaging Using Compressed Sensing Acceleration: Optimization and Comparison with Conventional 2D FSE Imaging for Detection of Internal Derangement of the Knee

Michael Paul Recht MD (Presenter): Nothing to Disclose , Ricardo Otazo : Nothing to Disclose , Christian Geppert : Employee, Siemens AG , Christopher Glielmi PhD : Employee, Siemens AG , Mary Bruno RT : Nothing to Disclose , Esther Raithel PhD : Employee, Siemens AG , Guobin Li : Nothing to Disclose , Soterios Gyftopoulos MD : Nothing to Disclose , Catherine Niyada Petchprapa MD : Nothing to Disclose , Leon David Rybak MD : Nothing to Disclose

PURPOSE

To develop and optimize a 3D FSE(SPACE) sequence using compressed sensing (CS) acceleration that demonstrates similar accuracy as 2D FSE sequences for the detection of internal derangement of the knee.

METHOD AND MATERIALS

An accelerated SPACE sequence was developed using CS with undersampling of the two phase-encoding dimensions. The following parameters were optimized: acceleration factor, turbo factor(TF), TR, TE, voxel size, fat suppression, and the presence or absence of a magnetization transfer(MT) pulse. Following optimization, 49 consecutive patients undergoing knee MR examinations were imaged on a 3T scanner with a TxRx 15 channel knee coil using our standard MR protocol (sagittal PDW and FS T2W, coronal PDW and FS PDW, and axial FS T2W 2D FSE sequences, total scan time (TA)10:56) and the optimized SPACE sequence(TA 4:36). CS reconstruction was performed in the sagittal plane using a 3D wavelet transform. Images were then reformatted in all 3 orthogonal planes at 1.5 mm thickness. Three MSK radiologists evaluated the SPACE and 2D FSE images for each patient at two separate readout sessions.

RESULTS

Optimal parameters for the SPACE sequence were: TR 1200, TE33, TF45, variable flip angle evolution with PD weighting, CS undersampling factor of 6, fat suppression, presence of an optimized MT module, and 0.5x0.5x0.6 mm voxel size. Agreement between the SPACE and 2D FSE sequences for the three readers were: menisci- 93%,95%,96%; ligaments-98%,99%,99%;bone marrow edema-90%,94%,93%;cartilage-84%,88%,92%.

CONCLUSION

Clinical utility of 3D FSE images has been limited by several factors including long acquisition time, blurring, suboptimal resolution, and decreased contrast compared to 2D FSE images. Utilizing compressed sensing and an optimized MT module, an optimized SPACE sequence achieved similar contrast and resolution to 2D FSE images with a clinically acceptable TA of 4:36 min. This sequence demonstrated excellent correlation with 2D FSE images for the detection of meniscal and ligamentous tears, and bone marrow edema. There was greater discrepancy for the detection of cartilage abnormalities though the lack of arthroscopic correlation in this study precluded determination of true accuracy for chondral pathology.

CLINICAL RELEVANCE/APPLICATION

An optimized 3D FSE sequence with CS acceleration has the potential to replace 2D FSE sequences for evaluation of internal derangement of the knee with significantly shorter MR scan times.
Early Initiation of Salvage Androgen Deprivation Therapy Is Associated with Decreased Mortality Following Biochemical Failure Post-Salvage Radiation Therapy

Corey Foster (Presenter): Nothing to Disclose, William Jackson MD: Nothing to Disclose, Benjamin Foster BS: Nothing to Disclose, Skyler Johnson MD: Nothing to Disclose, Felix Yi-Chung Feng MD: Nothing to Disclose, Daniel Allan Hamstra MD, PhD: Research Grant, Novartis AG Speaker, Varian Medical Systems, Inc

ABSTRACT

Purpose/Objective(s): The appropriate time to initiate salvage androgen deprivation therapy (SADT) following the treatment and biochemical recurrence of localized prostate cancer remains controversial. We chose to investigate if early initiation of SADT is associated with improved clinical outcomes following biochemical failure (BF) post-salvage radiation therapy (SRT) Materials/Methods: The medical records of 575 patients treated with SRT at a single institution between 1986 and 2010 were retrospectively reviewed. Of the 250 patients experiencing BF post-SRT, 172 patients (69%) had a calculable prostate-specific antigen doubling time (PSADT) prior to initiation of SADT. These patients comprise the cohort used for analysis and were divided into four groups as follows: those with PSADTs > 3 months without distant metastasis (DM) at SADT initiation (group 1, n=62), those with PSADTs < 3 months without DM at SADT initiation (group 2, n=28), those with DM at SADT initiation (group 3, n=52), and those not receiving SADT during follow-up (group 4, n=50). Group 1 was considered to have received early SADT while groups 2 and 3 were considered to have received late SADT. Endpoints included prostate cancer-specific mortality (PCSM) and overall mortality (OM). Kaplan-Meier methods were used to estimate survival, and Cox proportional hazards models were used for multivariate analysis Results: Median follow-up post-SRT was 7.9 years. PCSM significantly differed among the four groups (p=0.001) with 5-year rates of PCSM being 3%, 24%, 13%, and 0% for groups 1-4, respectively. PCSM and OM did not significantly differ between groups 1 and 4 or groups 2 and 3. Of note, patients in group 4 had a median follow-up post-BF of 3.6 years (range: 0.4-15.3) and had very long PSADTs (median = 27.0 months, interquartile range [IQR]: 13.6-47.7) that were significantly longer than those of group 1 (median = 6.0 months, IQR: 4.5-9.5) (p<0.001). Patients receiving late SADT were at significantly increased risk for PCSM (hazard ratio [HR]: 2.8, 95% confidence interval [CI]: 1.4-5.5, p=0.005) and OM (HR: 1.9, 95%CI: 1.0-3.5, p=0.04) compared to those receiving early SADT. Multivariate analysis including groups 1-3 while controlling for comorbidity, pathologic variables, presence of DM at SADT initiation, and PSA at SADT initiation found a pre-SADT PSADT < 3 months to be the only significant predictor of PCSM (HR: 4.0, 95%CI: 1.6-10.1, p=0.003) and OM (HR: 2.9, 95%CI: 1.3-6.5, p=0.004). Conclusions: For patients experiencing BF post-SRT, early initiation of SADT is associated with decreased PCSM and OM; however, observation may be a reasonable alternative for patients with very long PSADTs. A PSADT < 3 months prior to SADT initiation significantly predicts an increased risk of PCSM and OM in this patient demographic.

Analysis of the Relationship between Dose Inhomogeneity and Local Control in Patients with Prostate Cancer Treated with Permanent Seeds Brachytherapy

Fumitaka Ito MD (Presenter): Nothing to Disclose, Hidetoshi Kobayashi MD, PhD: Nothing to Disclose, Yumi Oie: Nothing to Disclose, Hidekazu Hattori MD: Nothing to Disclose, Hiroshi Toyama: Nothing to Disclose, Masayuki Ito: Nothing to Disclose

ABSTRACT

Purpose: Excellent biochemical relapse free survival with low dose rate I-125 brachytherapy for patients with early prostate cancer is demonstrated. Dose escalation may be feasible, but the balance between tumor control and normal tissue damage is critical to outcome and morbidity. Dose delivered to 90% of prostate is reported to be closely correlated with outcome. Low delivered dose is one of the origin of recurrence, so inhomogeneity is suspected to be an important predictor. In this paper, the relation between biochemical failure free survival and dose inhomogeneity were evaluated. Material and methods: Five hundred twenty nine prostate cancer patients treated with permanent brachytherapy using I-125 seeds from 2006 to 2012. PSA failure was determined according to the Phoenix definition. The prescription dose was: low risk 160Gy brachytherapy only in low risk, 110Gy brachytherapy after 45Gy adjuvant EBRT intermediate risk and high risk. These grouping is from risk classification described by D’Amico. Results: Twenty three patients showed PSA failure. In 23, 14 are under observation, 7 patients were treated with endocrine therapy, and 2 patients underwent operation of robot assisted radical prostatectomy (by da Vinci S). The pathologically proved recurrence lesions were coincided with cold dose areas of post-plan. In order to evaluate the relation between dose insufficiency and recurrence, the prostate DVH of biological failure patients were compared with that of control cases, who were free from PSA failure. The prostate DVH of biological failure patients showed lower dose curve compared with the control cases, at points from V80 to V200 in prostate DVH. Conclusion: Dose inhomogeneity is one of the reason of biochemical failure of permanent prostate brachytherapy. Ratio of volume of prostate receiving 100% or 150% of prescribed dose (V100, V150), which are indexes of homogeneity, are important indexes.

Hypoxia Modification during Prostate Radiotherapy. An Evaluation of Changes in the Tumor Microenvironment Using Multi-parametric MRI (mpMRI)

Kent Yip MRCP, FRCR (Presenter): Nothing to Disclose, Juliette Valentine MSC: Nothing to Disclose, James Stirling: Nothing to Disclose, Ian Simcock: Nothing to Disclose, N.Jane Taylor PhD: Nothing to Disclose, David John Collins BSc, BA: Nothing to Disclose, James A. D Arcy: Nothing to Disclose, Uma...
Hydroxyurea improves survival in patients treated with radiotherapy (RT) for some cancers. Previous studies have shown the presence of hydroxyurea in untreated prostate cancer (PCa) and hydroxyurea resolution following hydroxyurea breathing. Androgen deprivation therapy (ADT) is normally given prior to RT. Because ADT is anti-angiogenic, its not known whether the use of carbogen gas will still be effective in correcting hydroxyurea post ADT. This study has assessed this during hydroxyurea modified RT.

METHOD AND MATERIALS

50 men with high risk PCa took part in a phase II trial of prostate RT with hydroxyurea modification using carbogen gas and nicotinamide. 20 men also underwent serial mpMRI examination. 6 scans were carried out: 1st immediately prior to ADT (3 months pre RT); 2nd and 3rd (reproductibility pair) 1 week pre RT and 3 months into ADT; 4th, 5th and 6th at weeks 1, 3 and 7 of RT. The following sequences were carried out: T2-weighted; Dynamic Contrast Enhanced MRI; Intrinsic Susceptibility Contrast MRI (pre and post carbogen) and Diffusion Weighted MRI. Tumors were identified and outlined on the T2W and DW-MRI images on each scan for every time point. Voxel based calculations were performed to derive Ktrans, IAUGC60 and R2*. The extended Tofts' Model was used for data fitting to calculate Ktrans. Percentage change in R2* compared to baseline values for each day was calculated.

RESULTS

The changes in all the parameters are presented in table 1. Basal tumor R2* increased by 17% after 3 months of ADT compared to baseline. Carbogen administration caused a drop in delta R2* at all time points, by as much as 10%. Whole prostate Ktrans and IAUGC60 reduced after 3 months of ADT and then recovered during RT.

CONCLUSION

Reductions in blood flow and worsening in tumor hydroxyurea were seen after the 3 months of ADT. Despite this, tumors remained responsive to carbogen. The increase in blood supply during RT may explain the preservation of response to hydroxyurea modification.

CLINICAL RELEVANCE/APPLICATION

The strategy of using carbogen to overcome intra-tumoral hydroxyurea remains valid for prostate cancer even with the prior use of ADT. Phase III testing of this hydroxyurea modification strategy can proceed, provided acceptable toxicity is confirmed in this phase II trial.
Sub-Events

SSJ25-01  Endovascular Renal Chimney Stent-graft Technique in Patient with Hostile Proximal Neck: Technique and Acute/Mid-term Results

Vladimir Gavrilovic MD : Nothing to Disclose, Gianluca Piccoli MD (Presenter): Nothing to Disclose, Massimo Sponza : Nothing to Disclose, Alessandro Vit : Nothing to Disclose, Massimo Bazzocchi MD : Nothing to Disclose, Daniele Gasparini : Nothing to Disclose

PURPOSE

To evaluate feasibility, safety and efficacy of Chimney-EVAR (Ch-EVAR) technique in patient with hostile proximal neck for standard EVAR.

METHOD AND MATERIALS

From March 2009 until December 2013, 43 patients considered at high surgical risk underwent Ch-EVAR. Balloon-expandable or self-expandable stent-graft were implanted in the renal arteries, of which 10 bilaterally and 33 unilaterally. In all 43 patients 6-15 ml of fibrin glue were injected into the sac using a 5F catheter to obtain complete thrombosis and reduce the risk of late type-2 leak. The results of the Ch-EVAR procedure were evaluated at 1, 6 and 12 months and annually by CT angiography (CTA), and clinically (serum creatinine) at 24h, 1 month and 6 months and annually thereafter.

RESULTS

Ch-EVAR technique was feasible in all patients. Final angiogram proved the exclusion of the sac, and no type 1 endoleaks. Mean follow-up was 16 (1-38) months. Average serum creatinine before the procedure and at 1, 6 and 12 months follow-up (FU) was respectively 1.4, 1.9, 1.5 and 1.3 ml/dl. In five patients creatinine increased significantly within 24h post-procedure, and a CT angiogram showed renal stent thrombosis; three patients were revascularized successfully whereas the two were considered not revascularizable. Eight patients died during the follow-up (non aortic death); all other patient were alive in stable clinical condition at FU.

CONCLUSION

According to our preliminary experience, Ch-EVAR technique is feasible, safe, and effective to treat patients with hostile proximal neck in AAA. Acute stent thrombosis is quite rare but possible complication, dayli serum creatinine monitoring is mandatory in the postoperative period.

CLINICAL RELEVANCE/APPLICATION

Ch-EVAR technique is good option for non-surgical, and AAA patients with hostile proximal neck. It is complex and high skills demanded procedure. The most frequent complication is acute stent thrombosis.

SSJ25-02  Impact of Thoracic Endografting on the Native Aortic Haemodynamics: Quantitative Comparative Analysis of the Functional Assessments by CT-computational Fluid Dynamics (CFD) Imaging before and after the Device Implantation

Marco Midulla MD, PhD (Presenter): Nothing to Disclose, Ramiro Moreno MS : Nothing to Disclose, Stephan Haulon : Nothing to Disclose, Franc Nicoud : Nothing to Disclose, Christophe Demattei : Nothing to Disclose, Jean-Paul Beregi MD : Nothing to Disclose, Anne Negre-Salvayre : Nothing to Disclose, Jean-Pierre Pruvo MD, PhD : Nothing to Disclose, Herve Pierre Rousseau MD : Nothing to Disclose

PURPOSE

Endovascular repair has dramatically changed the physicians approach to the thoracic aortic pathology. Although the advancements in clinical experience, little is known about the impact of the implantation on the native aortic functional status. The aim of this study is to evaluate the haemodynamic modifications before and after the endografting by proposing a comparative analysis of the quantitative assessments by a CT-based Computational Fluid Dynamics Imaging.
METHOD AND MATERIALS

40 patient-specific aortic geometries were obtained from an image dataset of pre and postoperative angio CT acquisitions in 20 consecutive patients treated by thoracic endografting for different aortic pathologies (11 TAA, 5 False Aneurysms, 3 Penetrating Ulcers, 1 ATAR). After image processing, a commercially available software system (XFlow, Next Limit Technologies) using a particle-based meshless approach was adopted to obtain the numerical simulations of the flow behaviour. WSS (Pa) and vorticity (Hz) values were measured at the proximal and distal landing zones and the median pre-postoperative ratios were registered.

RESULTS

Haemodynamic simulations were obtained for all the patients and quantitative analyses were accomplished (technical success 100%). Median WSS ratios respectively at the proximal and distal landing zone were: 0.96 (median values 4.19, 4.90 Pa) and 0.83 (median values 1.66, 2.06). Concerning the vorticity, median ratios were respectively 1.01 (proximal zone; median values 15.16, 17.22 Pa) and 0.80 (distal zone; median values 15.16, 17.22 Hz). Statistical analysis showed a difference in WSS (P=0.02) and vorticity (P=0.03) at the proximal landing zone depending on the specific anatomical implantation site (Z2-Z4).

CONCLUSION

A CT-based CFD approach is a promising imaging tool to obtain haemodynamic simulations of the thoracic aortic environment. The approach adopted in this experience allowed to accomplish a preliminary quantitative analysis comparing the pre and postoperative functional status which encourages next larger studies to gain better understanding of the impact of the endovascular treatment on the native vessel.

CLINICAL RELEVANCE/APPLICATION

To provide an imaging tool for the investigation of the thoracic aorta haemodynamics in order to weigh up the functional impact of endografting on the native vessel.

SSJ25-03

Additional Value of Venous Phase to Whole-body CT Angiography in Patients with Aortic Aneurysm

Yukichi Tanahashi MD (Presenter): Nothing to Disclose, Satoshi Goshima MD, PhD: Nothing to Disclose, Hiroshi Kondo MD: Nothing to Disclose, Yoshifumi Noda MD: Nothing to Disclose, Nobuyuki Kawai MD: Nothing to Disclose, Hiroshi Kawada MD: Nothing to Disclose, Haruo Watanabe MD: Nothing to Disclose, Kota Sakurai: Nothing to Disclose, Masayuki Kanematsu MD: Nothing to Disclose

PURPOSE

To evaluate the diagnostic performance of added venous phase for the detection and characterization of incidentaloma in patients with aortic aneurysm.

METHOD AND MATERIALS

IRB approval and written informed consent was obtained. Consecutive 243 patients (209 men, 34 women; mean age, 75.6 years) underwent whole-body contrast-enhanced CT in arterial- and venous- phase, following unenhanced image, for the assessment of aortic aneurysm. Two observers independently and randomly reviewed images in two separate image set; 1st, unenhanced and arterial phase images, and 2nd, unenhanced, arterial-, and venous-phase images, for the evaluation of incidentaloma. Incidentalomas were scored by a five-point rating scale for the confidence level of malignancy probability. Sensitivity, specificity and areas under the receiver operating characteristic curve (AUC) for the detection of visceral malignant lesion between two image sets were evaluated.

RESULTS

Diagnosis of visceral malignant tumors in 15 patients were established pathologically (n = 10) and diagnostic imaging (n = 14). The sensitivity and specificity for the detection of visceral malignant tumor were significantly higher in 2nd image set (80% and 94%) than those in 1st image set (60% and 77%) in observers overall. AUCs for Observer 1 and 2 were significantly higher in 2nd image set (0.93 and 0.95) than in 1st image set (0.83 and 0.81) (P = 0.03 and 0.01).

CONCLUSION

Diagnostic performance of incidental visceral malignancy was significantly improved by adding venous-phase to whole-body CT angiography.

CLINICAL RELEVANCE/APPLICATION

The prevalence rate of malignancy in the patients with aortic aneurysms was higher because they are commonly at an old age. Our result demonstrated the additional value of venous-phase to whole-body CT angiography for the detection and characterization of incidentaloma. This information might be beneficial for the assessment of these patients.

SSJ25-04

Incidence and CT Angiographic Characteristics of Aortic Re-Dissection: A 10-Year Single Center Experience
PURPOSE

Patients with prior aortic dissection remain at risk for repeat events, particularly those with hereditary aortopathy. CT angiographic (CTA) findings of acute aortic lesions superimposed on prior chronic dissection may be difficult to interpret. Our aim is to evaluate the incidence of aortic re-dissection in the clinical setting of acute aortic syndrome (AAS), and describe CTA imaging characteristics and clinical outcomes.

METHOD AND MATERIALS

CTAs from Jan 1, 2003 - Dec 31, 2012 in 497 patients presenting to a single institution with AAS were retrospectively reviewed by two cardiovascular radiologists. Aortic re-dissection was defined as an acute aortic lesion occurring in the same aortic segment affected by a prior aortic dissection, greater than 30 days after the initial aortic event. Patients with age-indeterminant lesions were excluded.

RESULTS

A total of 513 AAS occurred over the 10-year study period. The incidence of aortic re-dissection was 2.3% (12/513). The time interval between the historic event and the acute re-dissection ranged from 38-1777 days. The mean age of patients with re-dissection was 55.2 years (range 43-68 years); a third had a history of Marfan's syndrome. There were 7 new classic aortic dissection (AD) and 5 intramural hematoma (IMH) re-dissections. There were 2 type A and 10 type B lesions. One re-dissection was complicated by aortic rupture. AD re-dissections had the unique CTA characteristic of 2 intimal-medial flaps and 3 flow lumens, typically involving the original false lumen, IMH re-dissections had acute extensive intramural hemorrhage within the false lumen of prior chronic AD. Both type A and 4/10 type B lesions underwent surgical repair.

CONCLUSION

Aortic re-dissection within a chronic dissection is rare, but can present with AAS indistinguishable from the first event. CTA imaging characteristics are unique given persistent findings of the initial dissection, but can confirm the presence of a new acute aortic lesion. The false lumen of re-dissections often expands quickly, and urgent treatment is required. While the true incidence of rupture and death from re-dissection remains unknown, these lesions tend to be unstable requiring surgical repair.

CLINICAL RELEVANCE/APPLICATION

Aortic re-dissection is rare but can present as an acute aortic syndrome. CTA can confirm the presence of a new acute aortic lesion in the same aortic segment, despite persistence of the prior chronic dissection.

To Assess the Feasibility and Value of Multiphasic Dynamic Scan Protocol in Aortic Dissection

SSJ25-05

Yike Diao (Presenter): Nothing to Disclose, Chun-Yan Lu: Nothing to Disclose, Xiaohui Zhang: Employee, Siemens AG, Zhenlin Li MD: Nothing to Disclose

PURPOSE

To assess feasibility and additional diagnostic value of low dose multiphasic CT dynamic protocols (Shuttle mode and Flash-4D mode) in aortic dissection (AD) compared to a standard tri-phase protocol on a dual source CT (DSCT) scanner.

METHOD AND MATERIALS

54 consecutive patients with known or suspected AD (age range:30-77 years) referred for aortic CTA were randomly, equally assigned into three groups and scanned on a DSCT scanner (SOMATOM Definition Flash, Siemens). For group A,a shuttle mode (Siemens) of multiphasic image acquisition (range: 48cm, time resolution 6s, 4 phase, 80kV, 125mAs/rot), for group B a high-pitch (pitch=3.0) mode of multiphasic image acquisition (range from the entrance of bony thorax to the plane of symphysis pubis, time resolution 12s, 4 phases, CARE kV, ref 80kV, 100mAs/rot), for group C the standard tri-phasic acquisition (range from the entrance of bony thorax to the plane of symphysis pubis, 100kV, 210mAs/rot) was used. Radiation dose were recorded. One-way ANOVA was used for statistical analysis.

RESULTS

In all 54 cases CTA can exactly display the true and false lumen, intimal flap, the entry tear and the involvement of branches of AD. Compared to standard tri-phasic protocol (un-enhanced, arterial and portal scans), additional diagnostic information was obtained by multiphasic CT dynamic protocols as followed: the enhancement delay between the true and false lumen (group A=18; group B=18); the degree of membrane oscillation (group A=8; group B=14); dynamic ejection of contrast material from the true into the false lumen (group A=6; group B=7). Mean effective radiation dose (group A: 8.08±0.12mSv, group B: 11.60±0.3mSv, group C: 23.86±1.31mSv) of the three groups were shown statistically different (P<0.05).Scan length range of Flash-4D CTA is approximately 62.63±4.44 cm, longer than shuttle mode (fixed 48cm).

CONCLUSION

Multiphasic dynamic CTA covering the entire aorta is feasible. Compared to standard tri-phasic protocol, both multiphasic scan protocols can provide more reveal pathological and anatomical features of AD with relative low radiation dose. In Flash-4D mode larger scan range can be provided, however, shuttle mode has a better time-resolution.

CLINICAL RELEVANCE/APPLICATION

SSJ25-05
Multiphasic protocols can exactly reveal pathological and anatomical features of AD with relative low radiation dose and offer more diagnostic information for surgical operation.

SSJ25-06 Treatment of Native Coarctation of the Aorta in Adult and Adolescents Using Covered-Stent Implantation

Xiaoyong Huang (Presenter): Nothing to Disclose, Jiaqing Fu: Nothing to Disclose, Lianjun Huang: Nothing to Disclose, XI GUO: Nothing to Disclose, Xin Pu: Nothing to Disclose

PURPOSE

Coarctation of the aorta (CoA) is a common congenital malformation leading to a life expectancy of about 35 years unless corrected. This study was to investigate the safety and effectiveness of treatment of native CoA in adults and adolescents using covered-stent implantation.

METHOD AND MATERIALS

A retrospective analysis was performed in 33 patients (mean age: 21.3±9.1 years, mean weight: 52.7±8.3 kg) diagnosed with native CoA by CT angiography and who accepted stent implantation from April 2005 to June 2012. Mean CoA diameter was 4.2±1.8 mm and mean length was 14.63±4.64 mm. Blood pressure monitoring, and CT angiography were performed 6, 12 and 24 months after surgery.

RESULTS

The procedures were successful in all cases, without major complications. Peak systolic pressure gradient decreased from 63.8±17.6 mmHg to 6.5±2.1 mmHg (P=0.005). Mean CoA diameter increased from 4.2±1.8 mm to 18.9±1.9mm (P=0.001). Eight patients with patent ductus arteriosus had no persistent left-to-right shunt after covered Cheatham-Platinum stent implantation. Pressure gradient was still present after implantation in one case with combined aortic arch dysplasia, and a longer bare stent was implanted to overlap the Cheatham-Platinum stent. Mean follow-up was 37.4±21.9 months. During this period, one patient with sustained hypertension needed medical control, without retraction observed on CT angiography. All other patients had improved symptoms and good hypertension control. There was no significant difference in peak systolic pressure between upper and lower extremities (P>0.05).

CONCLUSION

Covered-stent implantation in adults and adolescents with native CoA is efficient and safe, with good intermediate result.

CLINICAL RELEVANCE/APPLICATION

Covered-stent implantation is an efficient and safe method in the treatment of native CoA in adults and adolescents, with a good intermediate result.

SSJ26 Vascular/Interventional (IR: Venous Disease and Intervention)

SSJ26-01 Feasibility and Safety of Image-guided Percutaneous Ablation for Treatment of Symptomatic Vascular Malformations Following Failed Percutaneous Sclerotherapy

Scott M. Thompson BA (Presenter): Nothing to Disclose, Matthew Raymond Callstrom MD, PhD: Research Grant, Thermedical, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Galil Medical Ltd, Michael A. McKusick MD: Nothing to Disclose, David Arthur Woodrum MD, PhD: Nothing to Disclose

PURPOSE

To determine the feasibility and safety of image-guided percutaneous ablation for treatment of symptomatic vascular malformations

METHOD AND MATERIALS

An IRB-approved retrospective review was undertaken of all patients who underwent image-guided
percutaneous ablation of symptomatic vascular malformations (VMs) that failed percutaneous Sotradecol or ethanol sclerotherapy. Ablations were performed under general anesthesia with US/CT or MRI-guided cryoablation or MRI-guided laser ablation. Cryoprobes or laser fibers were placed under intermittent CT or MR imaging. Intraprocedural monitoring was performed with intermittent CT or MRI during cryoablation to monitor ice-ball formation or with proton-resonance frequency MR thermometry every seven seconds during laser ablation to monitor thermal changes. Post-ablation monitoring varied between observation or hospital admission. Clinical follow-up began at one month post-ablation.

RESULTS

Seven patients (ages 10 to 48; 4 female) with eight VMs (N=7 intramuscular; N=1 subcutaneous) were treated with US/CT (N=3) or MRI-guided (N=2) cryoablation or MRI-guided laser ablation (N=3) for pain (N=6) or diffuse bleeding secondary to hemangiomatous-thrombocytopenia syndrome (N=1). The median (range) of the maximal diameter was 9 cm (6.5 to 11.1 cm) for VMs undergoing cryoablation and 2.5 cm (2.3 to 5.3 cm) for laser ablation. Seven VMs were ablated in one session and one in a planned two-stage session. Two laser fibers and 3 to 10 cryoprobes were used per ablation session. The number of hospital days ranged from 1 to 3 for cryoablation and 0 to 1 for laser ablation. Minor complications included a small hematoma, which did not require further intervention (laser) and numbness of the dorsal aspect of first toe (cryoablation). There were no major complications. There was no recurrence of bleeding at four years post ablation in the patient with hemangiomatous-thrombocytopenia syndrome and 5 of 6 patients with painful VMs reported symptomatic pain relief beginning as early as one month post ablation.

CONCLUSION

Image-guided percutaneous ablation of symptomatic vascular malformations is feasible and safe in patients who have failed percutaneous sclerotherapy and provides symptomatic relief for the majority of patients at short-term follow-up.

CLINICAL RELEVANCE/APPLICATION

Image-guided percutaneous ablation warrants further investigation as a therapeutic modality for treatment of symptomatic vascular malformations.

Complications Related to Inferior Vena Cava Filters: A Retrospective Analysis Utilizing Computed Tomography

Dominic Semaan MD, JD (Presenter): Nothing to Disclose, Matthew Osher MD: Nothing to Disclose, Ashish Vyas MD: Nothing to Disclose, Aaron Joseph Burgin MD: Nothing to Disclose, Roger L. Gonda MD: Nothing to Disclose, Laurie Marie Vance MD: Nothing to Disclose

PURPOSE

The purpose of our review is to determine the incidence of complications related to IVC filter placement, as well as to determine which type of IVC filters have the greatest incidence of complications, utilizing subsequent post-deployment computed tomography.

METHOD AND MATERIALS

A retrospective analysis was performed of all IVC filters placed at our institution between 6/1/2010 and 6/21/2013, including the medical records and related imaging. This query totaled 621 filters deployed by our department, of which 188 of those filters had subsequent computed tomography performed at our institution. The incidence of IVCF caval penetration was determined pursuant to the SIR practice guidelines.

RESULTS

A total of 188 filters were reviewed. Of those, 88 (36.2%) had caval penetration, 3 migrated from original placement, 3 filters had a fractured strut. Major caval penetration into adjacent viscera/aorta was seen in 6 of the filters deployed. Incidentally, 3 patients developed caval thrombosis. Chi-square analysis demonstrated a statistically significant difference in the incidence of caval penetration between the various filters deployed (p < .001). Of the various types of filters utilized by our institution (Günther Tulip N=28, Celect N=47, Option N=97, Trapese N=10, Eclipse N=2), the Günther Tulip demonstrated the greatest incidence of caval penetration at 71.4%. While only 32.0% of Option filters demonstrated caval penetration, two filters had struts penetrate into the adjacent aorta. The Option demonstrated the highest incidence of migration, with 2 (2.1%) filters averaging 2.4 cm of cephalic migration. Two Celect and one Trapese filter had fractured struts, which could potentially serve as a source of future embolism.

CONCLUSION

Interventional radiologists must be evermore cognizant of potential risks of filter deployment. IVC filter placement is not a benign procedure and carries risk to the patient, both intra- and post-procedural. Patients and referring physicians should be educated regarding these risks and the decision to implant an IVC filter, often for the remainder of the patient’s life, is not one that should be taken lightly.

CLINICAL RELEVANCE/APPLICATION

IVC filter placement must be carefully evaluated prior to filter placement, to determine if the risks (including caval penetration) are outweighed by the benefits.
Pharmacomechanical Catheter-directed Thrombolysis in Patients with IVC Filters

PURPOSE
To evaluate the authors’ experience with pharmacomechanical catheter-directed thrombolysis (PCDT) in patients with inferior vena cava (IVC) filters.

METHOD AND MATERIALS
Retrospectively queried radiology reports from 1/2005-2/2014 identified patients with IVC filters undergoing PCDT (catheter-directed thrombolysis, mechanical thrombectomy, balloon maceration, angioplasty and stenting). Patient electronic medical records were reviewed for: demographic, anticoagulation, symptoms, extremities involved, extent of thrombosis, therapies received, number of sessions, technical and clinical success, complications, need for subsequent lysis and long-term status. Statistic analyses were performed using SPSS software.

RESULTS
Eighty-two patients met criteria (53yrs; range 18-96, M:66%). The most common indication for PCDT was lower extremity pain and edema (68%) with ulceration, phlegmasia, and compartment syndrome, combined accounting for 16% and pulmonary embolism for 12% of patients. Of the 80 patients with lower extremity symptoms, 60% were bilateral, resulting in 129 extremities at risk. Catheter venography demonstrated IVC thrombus in 89% with extension above the filter in 22% of patients. Thrombus was confined to extremities in 5%, while IVC with both iliac vessel involvement was identified in 64% of patients. Treatment mostly involved combined mechanical and lytic therapy with angioplasty and stenting in 57% and 50% of patients, respectively. PCDT was technically successful in restoring flow in 88% and clinically successful in improving symptoms in 80%. IVC filters remained functional in 70%. By SIR criteria, 85% had no or minor complications. There were 2 deaths from intracranial hemorrhage. On follow up (458 days avg; 0-3011D), 6% of patients died from thrombosis related events, 17% underwent repeat lysis procedures within our hospital system and 54% of patients had resolved/improved symptoms. The complication rates in the patients with single versus bilateral lower extremity involvement were similar. Long-term thrombosis related death was 17% in patients with thrombus extending above the filter vs. 3% in patients with no thrombus extension above the filter.

CONCLUSION
Pharmacomechanical catheter-directed thrombolysis is an effective and safe treatment in patients with pre-existing IVC filters.

CLINICAL RELEVANCE/APPLICATION
Aid the proceduralist in treating DVT in patients with IVC filters. Data helps guide informed consent.

Effectiveness of Simulation-based IVC Filter Placement Training for Radiology Residents: A Pilot Study

PURPOSE
To assess whether high-fidelity simulation-based training is more effective than standard didactics to train radiology residents in IVC filter placement and the perceptive validity of simulation-based training.

METHOD AND MATERIALS
This is an IRB approved prospective pilot study using a high-fidelity endovascular simulator. Between 9/1/13-3/1/14, 20 radiology residents (R1-R4) were randomized into a simulation group (SG, n=10) vs a control group (CG, n=10). All underwent a pretest including procedure simulation and written knowledge test. Both groups received didactic resources on IVC filter placement, but only SG underwent 3 simulation training sessions. Both groups underwent a posttest simulation, written test, and a subjective questionnaire. Simulation tests were evaluated by a blinded board certified interventional radiologist using a task-specific checklist and a 5 point Likert scale technical competence score. Total procedure time, fluoroscopy time, and written test scores were also recorded. Non-parametric tests and unpaired two-tailed t test were used to compare performance outcomes between two groups.

RESULTS
The SG demonstrated significant improvement in all parameters including technical competence (mean +2.1 points; P<0.01), procedure time (-8.08 min; P<0.01); fluoroscopy time (-1.03 min ;P=0.04), and written test score (+26%; P=0.01). The CG demonstrated significant improvement in only the procedure time (-7.21min; P=0.02) and written test score(+18%;P=0.01). Only the difference in technical competence score between the groups reached a statistical significance (P<0.01). Mean survey scores (SG,CG) were as follows: simulation realism(4.7,3.6), confidence after study completion(4.8,3.5), overall utility of simulation-based IVC filter training (4.8,4.2), benefit of simulation training in IR procedures(4.9,4.7). Self-confidence in IVC filter placement significantly improved in SG compared to CG (P<0.01).

CONCLUSION
Simulation based IVC filter placement training can be more effective than conventional teaching in gaining
technical proficiency and self-confidence among radiology residents. This pilot study provides evidence to support further investigation of simulation-based IR training in clinical practice.

**CLINICAL RELEVANCE/APPLICATION**

Simulation-based IR training may improve procedural skills, physician confidence, decrease procedure time and fluoroscopic time without patient morbidity or trainee radiation exposure.

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**SSJ26-05**

Cost Analysis of Chest Port Insertion: Interventional Radiology vs. Surgical Placement


**PURPOSE**

In the face of changing health care reimbursemens toward bundled care, the issue of minimizing cost is pertinent. While there has been a 20,510% increase in the number of chest ports (CP) placed by interventional radiologists from 1992-2011, surgery continues to dominate in placement of long term central venous access devices. This study compares the cost of CP insertions performed by interventional radiology (IR) vs. surgical implantation (OR) at a single institution.

**METHOD AND MATERIALS**

Cost data on 100 IR and 49 OR consecutive Medicare outpatients that had isolated chest port insertions between 3/2012-2/2013 was obtained for both the operative services (IR suite vs OR) and pharmacy. The costs incurred by the hospital were divided into variable labor, supplies, room, and fixed costs for each case. Each cost was summarized as mean and standard deviation. Non-parametric tests for heterogeneity were performed using Kruskal-wallis method. Alpha was fixed at 0.05 for statistical significance.

**RESULTS**

Overall mean charges to place a CP were significantly higher in the OR, both in room and pharmacy costs ($p < 0.0001$). The overall average cost to place chest ports in an OR setting was almost twice that of placement in the IR suite. There was not a single identifiable cause for this difference. Rather, every category of cost (labor, supply, variable and fixed room cost) was higher in the OR (see Figure 1). Furthermore, the costs in each category varied minimally between IR cases but demonstrated a much greater variance between OR cases. This pattern also holds true for pharmacy costs. Again, the pharmacy costs were greater and varied more for OR cases in every cost category except for pharmacy labor.

**CONCLUSION**

Cost incurred to the hospital demonstrated significant differences between surgeons and interventional radiologists. Given that our prior work shows that complication rates in CP insertions in these two services are similar,1 it can be concluded that IR services are more cost effective for chest port insertion.1 LaRoy J, et al. Morbidity Analysis of Chest Port Insertion: Interventional Radiology vs. Surgical Placement. J Vasc Interv Radiol 2014;25(3S):S100.

**CLINICAL RELEVANCE/APPLICATION**

Our findings suggest that there is a significantly lower cost associated with chest port placement performed in the IR suite.

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**SSJ26-06**

Flouroquinolone Based Surface Modifying Molecules Reduce Venous Thrombosis Rates Associated with PICC Lines


**PURPOSE**

To compare thrombosis rates between flouroquinolone surface modified polyurethane PICCs and polyurethane PICCs

**METHOD AND MATERIALS**

From 11/6/2012 through 2/6/2013, 1203 consecutive patients had 890 PICCs (642 Polyurethane [PU] and 246 Surface Modified Polyurethane [SM]) and 485 Midline catheters (481 PU and 5 SM). Catheter type was determined by preference of the placing nurse. In 10 patients, the type of PICC used was not recorded so these were excluded. Using multivariable logistic regression, rate of venous thrombosis associated with the catheter was compared between the two groups and correlated with variables such as age, gender, side of catheter placement, size of catheter, # of lumens, vein used, catheter length, whether the vein reached its desired target (SVC in PICC and Axillary Vein in Midlines), and an ICD-9 cancer diagnosis. Central Line Associated Bacterial Systemic Infections (CLABSI) were also collected.

**RESULTS**
In univariate analysis of PICCs, left side of insertion and cancer diagnosis were predictors of thrombosis (5.5% v. 2.1% for left v. right p=0.008 and 50% v. 2.5% p<0.0001 for cancer). In multiple-variable analysis correcting for age, side of placement and cancer diagnosis, there were 24 thromboses in 642 PU PICCs while there were only 3 in 248 SM PICCs with an odds ratio of 6.2 (p=0.01). In 5F catheters, the odds ratio was 5.0 (p=0.012). When 179 5F SM catheters were compared to 387 4F PU catheters the thrombosis rates were similar (p=0.272). There was no difference between 4F and 5F SM catheters. Thrombosis rate in PU midline catheters was higher than in PU PICCs (5.4% v. 3.7%). Side of placement was not a predictor of thrombosis. Shorter catheter length (p=0.014) and cancer diagnosis (p=0.002) were predictors of thrombosis in midlines. While no SM midlines thrombosed, the sample size was too small (n=5) for a generalizable comparison of midline catheters. There were no CLABSI events in either group.

CONCLUSION

Surface modification of PICCs reduces thrombosis by a factor of 6.2 overall and by a factor of 5 in 5F PICCs. Left sided PICC placement and cancer diagnosis increase the risk of venous thrombosis. Midline PU catheters have a higher associated thrombosis rate than PU PICC lines and while side of placement is not an independent risk factor for thrombosis, shorter length and cancer diagnosis are.

CLINICAL RELEVANCE/APPLICATION

Surface modified PICC lines have lower thrombosis rates which will improve patient safety.
We retrospectively reviewed children who visited our medical check-up clinic for the last two years. Age, sex, height, weight, body mass index, and laboratory findings including liver function tests, cholesterol, and triglyceride level were reviewed. Hepatic fat fraction (%) was measured on the dual- and triple-echo gradient-recalled-echo sequences of our routine check-up MR protocol performed at 3T. We excluded children with abnormal laboratory findings or overweight (body mass index more than 25 kg/m²). Paired t-test was used to compare dual and triple fat fraction. Pearson’s chi-squared test was used to evaluate the correlation between fat fraction and clinical or laboratory findings.

RESULTS

Among the total 72 children visited our clinic during the study period, 18 were excluded due to the abnormal laboratory findings or overweight. The enrolled 54 children (M:F = 26:28) were 5-15 years old with a mean of 9 years. Dual fat fraction (range 0.1-8.0%, mean 2.3 ± 2.0 %) was lower than triple fat fraction (range 0.4-6.5%, mean 2.9 ± 1.4 %) (p=0.006). Eight children (8/54, 15%) on dual and six children (6/54, 11%) on triple-echo sequences showed more than 5% fat fraction. In the correlation analysis, only dual fat fraction and triglyceride level was correlated significantly (Pearson’s correlation coefficient 0.314, p=0.021).

CONCLUSION

The upper limit of normal hepatic fat fraction was 8% on dual- and 6.5% on triple-echo sequences. Dual fat fraction was lower than triple fat fraction and correlated with triglyceride level in healthy children.

VSPD32-03 Preliminary Assessment of a Hi SNR mMRI Sequence for Use in Determination of Low Hepatic Proton Density Fat Fraction (PDFF) in Children


PURPOSE

Low signal-to-noise (SNR) could interfere with hepatic fat assessment by magnitude-based MRI (mMRI). The purpose of this study was to assess in children the accuracy of a high-SNR (Hi-SNR) mMRI sequence to determine hepatic proton density fat fraction (PDFF), at PDFF values less than ten percent.

METHOD AND MATERIALS

In this prospective, single-site, IRB approved, HIPAA compliant study, a Hi-SNR variant of an mMRI sequence was developed by increasing slice thickness from 8 to 10 mm, and decreasing matrix from 224x128 to 128x92. Pediatric subjects with known or suspected non-alcoholic fatty liver disease (NAFLD) were recruited, provided written informed consent, and underwent 3T MR examinations including mMRI and an advanced multi-TR-TE magnetic resonance spectroscopy (MRS) sequence capable of measuring T1 of water and fat as well as PDFF. The mMRI PDFF values used in this study are the means of three circular 1-cm radius regions of interest (ROIs) placed on source mMRIs co-localized to the MRS voxel location, one slice above that location, and one slice below that location. Linear regression models were used to assess accuracy of MRI-estimated PDFF for the three ROI locations, using multi TR-TE MRS PDFF as reference.

RESULTS

Standard and Hi-SNR mMRI, and multi-TR-TE MRS (to measure PDFF and T1) were obtained for 19 children (13 male, 6 female, age 11.8 ± 2.5 years). Regression analysis of Hi SNR mMRI using multi-TR-TE MRS had a slope, y-intercept and R² value, respectively, of 0.960, 1.216% and 0.993 for all 19 subjects; and 1.185, 0.602% and 0.822 for the 13 subjects with PDFF less than ten percent. Those values for standard mMRI were 0.987, 0.738% and 0.99 for all 19 subjects; and 1.139, 0.240% and 0.691 for the 13 subjects with PDFF less than ten percent.

CONCLUSION

In children with known or suspected NAFLD, correlation of Hi-SNR MRI PDFF with MRS was similar, or slightly improved compared to that for mMRI, for PDFF values less than ten percent.

CLINICAL RELEVANCE/APPLICATION

PDFF estimation using a high SNR mMRI variant sequence in children is feasible, and may be helpful if future research suggests that low SNR affects accuracy.

VSPD32-04 Diagnosis of Liver Rejection by Acoustic Radiation Force Impulse in Pediatric Liver Transplant Patients
PURPOSE

Acoustic radiation force impulse (ARFI) imaging has been developed as a new non-invasive ultrasound-based elastography modality to investigate liver stiffness using shear wave velocity (SWV). The aim of this study was to evaluate the role of ARFI imaging for assessing episodes of liver dysfunction (rejection, hepatitis, cholangitis and fibrosis) during the post-operative course after pediatric LT.

METHOD AND MATERIALS

ARFI was performed using an US device (Acuson S2000, Siemens Medical Solutions) equipped with a 4-MHz transducer. SWV by ARFI imaging was performed in 59 pediatric LT recipients (median 6 month after transplantation). Liver transplantation was performed with a full liver graft in 15 cases (25%) and with a split liver (segments II-III) in 44 (75%). SWV was measured ten times to quantify hepatic stiffness. Liver biopsy and laboratory analysis (including aminotransferases, alkaline phosphatases, albumin and bilirubin) were performed in a range of time from one day to one month from the ARFI imaging. SWV was compared to biochemical parameters using liver biopsy as reference standard. Data were evaluated retrospectively.

RESULTS

During the study period ARFI was performed 138 times. According to histopathology there were 15 rejections, 29 hepatitis episodes, 12 cholangitis episodes. Median SWV (m/s, IQR) was higher in patients with diagnosis of graft rejection than in patients without liver disease [2.03, 1.67-2.44, vs 1.22, 1.09-1.31, p < 0.01]. Median SWVs in patients with hepatitis and cholangitis were respectively 1.80, (IQR = 1.49-2.06) and 2.07 (IQR = 1.91-2.48). A few patients had fibrosis with a median SWV of 1.67 m/s. At ROC curve analysis ARFI resulted able to predict rejection (AUC = 0.932), hepatitis (AUC = 0.916) and cholangitis (AUC = 0.949). Statistical analysis wasn’t reliable for fibrosis (n = 4).

CONCLUSION

SWV obtained by ARFI predicts the diagnosis of rejection, hepatitis and cholangitis in pediatric liver transplantation independently to biochemical markers. ARFI could be useful to reduce the number of liver biopsy in order to guide the immunosuppressive therapy.

CLINICAL RELEVANCE/APPLICATION

ARFI, together with serological markers, is an efficient modality for the diagnosis of graft dysfunction allowing the reduction in the number of liver biopsies in pediatric patients after LT.
**VSPD32-06**  
**Imaging of Ambiguous Genitalia**  
Jeanne S. Chow MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the imaging findings on prenatal ultrasound which may alert the radiologist to the possibility of DSD, a proposed imaging evaluation for the postnatal evaluation of a newborn with DSD, and the most common types of DSD that we encounter in the newborn child.

**Active Handout**

**VSPD32-07**  
**CT and MR Enterography**  
Alex Towbin MD (Presenter): Author, Amirsys Inc Shareholder, Merge Healthcare Incorporated Consultant, Guerbet SA

**LEARNING OBJECTIVES**

1) Describe the advantages and disadvantages of performing CT and MR enterography in children. 2) Describe the protocol employed to perform CT and MR enterography in children. 3) Describe the most common imaging findings of pediatric inflammatory bowel disease.

**ABSTRACT**

Inflammatory bowel disease (IBD) is a general term used to describe the idiopathic inflammatory disorders of the gastrointestinal tract. The most common types of IBD are Crohn disease and ulcerative colitis. A number of imaging studies can be used to diagnose IBD in the pediatric population. Over the past ten years, CT and MR enterography have become the imaging tests-of-choice due to their image quality, speed of procedure, lack of bowel preparation, and ability to diagnose the extraintestinal complications of IBD. The purpose of this talk is to compare the advantages and disadvantages of CT and MR enterography, describe the unique components of the imaging protocol required to perform CT or MR enterography in children, and describe the common imaging findings of IBD in the pediatric population.

**VSPD32-08**  
**Magnetic Resonance Enterography Features of Mucosal Healing in Pediatric Patients with Crohn’s Disease**  
Matthew Paul Moy MD (Presenter): Nothing to Disclose, Jess Kaplan MD: Nothing to Disclose, Christopher James Moran MD: Nothing to Disclose, Harland Steven Winter MD: Consultant, PAREXEL International Corporation Consultant, Johnson & Johnson Consultant, Shire plc Consultant, Salix Pharmaceuticals, Inc Institutional Grant support, Johnson & Johnson Institutional Grant support, AstraZeneca PLC Institutional Grant support, Shire plc, Michael Stanley Gee MD, PhD: Nothing to Disclose

**PURPOSE**

We evaluated qualitative and quantitative magnetic resonance enterography (MRE) findings which best correlate with mucosal healing assessed by ileocolonoscopy as a reference standard.

**METHOD AND MATERIALS**

In this IRB-approved, HIPAA-compliant retrospective study, patients 18 years of age or below with Crohn’s disease were identified who underwent two ileocolonoscopy exams to assess disease activity with an MRE closely timed with the second endoscopy. Two pediatric gastroenterologists reviewed the paired endoscopic exams by consensus to assess inflammatory activity as reference. All bowel segments with macroscopic evidence of inflammation on the first endoscopy were included in the study, and were then categorized for the presence or absence of mucosal healing (MH) based on whether macroscopic inflammation was observed on the second endoscopy. An experienced pediatric abdominal radiologist evaluated the corresponding MRE exams of these patients, blinded to the endoscopic results, for multiple imaging features associated with active inflammation. Imaging-endoscopic correlation was then performed.

**RESULTS**

25 patients were included in the study (mean age 17.6 + 2.8 years) with a mean time between MRE and endoscopy of 12.4 + 7.3 days. On endoscopy, 38 bowel segments demonstrated MH and 22 segments demonstrated persistent inflammation. Among imaging features, MRI Index of Activity (MaRIA) score < 8 (accuracy 85%, sensitivity 89%, specificity 77%) and bowel wall thickness (WT) < 4mm (82%, 87%, 73%) were most strongly associated with MH (P < 0.0001, Fisher’s Exact Test). The average WT in healing segments was 2.7 + 0.9 mm compared with 5.2 + 2.2 mm in segments with persistent inflammation (P < 0.0001, Student’s t test). Other MRE features significantly (P < 0.005) associated with MH included mesenteric hypervascularity (78%, 97%, 45%), and bowel wall T2 hyperintensity (78%, 92%, 55%).
CONCLUSION
MRE is an accurate noninvasive technique for assessing mucosal healing in pediatric patients with Crohn's disease. The MRE features most strongly associated with MH include MaRIA score < 8 and WT < 4 mm.

CLINICAL RELEVANCE/APPLICATION
MRE assessment of mucosal healing has great potential in pediatric Crohn's disease as a noninvasive imaging biomarker of disease activity and a therapeutic endpoint of clinical trials.

VSPD32-09 Performance of Diffusion Weighted Sequences in Pediatric Patients with Inflammatory Bowel Diseases (IBD) Evaluated by MR-enterography
Celine Dubron (Presenter): Nothing to Disclose, Elisa Amzallag-Bellenger MD: Nothing to Disclose, Alain Duhamel: Nothing to Disclose, DOMINIQUE TURCK: Nothing to Disclose, Nathalie Boutry: Nothing to Disclose, Fred E. Avni MD, PhD: Nothing to Disclose

PURPOSE
Prospective evaluation of the performances of DWI for the detection of active lesions on MR-enterography in children with IBD.

METHOD AND MATERIALS
Sixty five children (mean age 12.9 years (3-18 years), median age 14 years) with suspected or known IBD were examined by MR-enterography (1.5 Tesla magnets Philips - Eindhoven and GE - Milwaukee). Preparation included pre-examination ingestion of a mixture of Mannitol and water. T2 weighted, T1 after Gadolinium injection and diffusion weighted sequences were obtained. All images were reviewed on a PACS system by two radiologists, each blinded to the clinical data and to the conclusion of the second reviewer. The digestive tract was divided into 7 segments. The 2 radiologists were asked to analyze the images obtained and to report on the presence of active lesions defined as bowel thickening observed on T2 sequences associated with contrast enhancement. The radiologists analyzed successively and independently the images obtained by combining T2 and DWI on one site, T2 and T1 + Gadolinium on the other. The latter was considered as the gold-standard. Whenever no agreement was observed, analysis with consensus was obtained. Inter-observers agreement and sensitivity, specificity, PPV and NPV were calculated.

RESULTS
The couple « T2 + diffusion » detected 64 lesions in 42 patients whereas the couple "T2 + T1 with Gadolinium" detected 58 lesions in 36 patients. The inter-observer agreement was excellent with a Kappa coefficient of 0.84. Sensitivity, specificity, PPV and NPV for the couple "T2+DWI" for the detection of active lesions of IBD were respectively 100 %, 96 %, 79 % and 100 %. The accuracy between the two techniques reached 97%, with Kappa coefficient of 0.86. Seven supplementary lesions were detected by DWI and not by T1+gadolinium. 5/7 had an endoscopic or histologic study confirming active lesions.

CONCLUSION
Associated with T2 weighted sequence, DWI have equivalent or probably better performances than T1+gadolinium.

CLINICAL RELEVANCE/APPLICATION
Its use would allow to perform shorter examination and obviate the need for gadolinium injection.

VSPD32-10 MR Enterography (MRE) Findings in Pediatric Ulcerative Colitis (PUC) vs Controls: The Added Value of DWI
Simone Chaudhary BSC, MSc (Presenter): Nothing to Disclose, Jorge Humberto Davila Acosta MD: Nothing to Disclose, David Mack MD: Nothing to Disclose, Ericc Benchimol MD: Nothing to Disclose, Elka Miller MD: Nothing to Disclose

PURPOSE
To compare DWI, post-gadolinium enhanced MRI (PGE) and bowel wall thickness (BWT) in active PUC with a group of normal controls on endoscopy.

METHOD AND MATERIALS
This is a retrospective study that included newly diagnosed patients with PUC who underwent MRE within 7 days after endoscopy and a group of controls with normal endoscopy findings. Bowel was divided in Cecum (Ce); ascending colon (AC); transverse colon (TC); descending colon (DC); sigmoid colon (SC); and rectum (Re). Terminal ileum was not affected. MRE was performed in a 1.5 T Magnet. Protocol included coronal and axial DWI, b=1000; pre- and post- gadolinium coronal dynamic multiphase and axial LAVA fat saturation. DWI was restricted (DR) if there was high signal intensity on b1000 and corresponding low signal intensity on the ADC map. PGE was positive if there was avid mucosal enhancement in comparison with the small bowel. Endoscopy was positive if ulceration, inflammation or edema were documented. Two readers were blinded to diagnosis and assessed BWT, DR and PGE in each segment. Interclass correlation (ICC) and Linear Mixed Effects Models with Random Intercept (LMEMRI) were calculated for BWT. Inter-rater reliability (kappa), sensitivity (Se) and specificity (Sp) for DWI and PGE were calculated.

RESULTS
Data from 15 patients with PUC and 15 normal controls was analyzed. Kappa values for DWI/PGE were:
CONCLUSION

PGE and DWI show high inter-rater reliability. Se of DWI detecting active PUC is superior to PGE; whereas specificity is comparable. BWT showed significant difference between active PUC versus controls, but these differences were only 0.5-1.5 mm

CLINICAL RELEVANCE/APPLICATION

Routine MRE should include DWI sequences which increase the degree of detection of active PUC within 7 days of diagnostic endoscopy with high sp values when compared with controls

Development and Validation of an Ultrasound Scoring System for Children with Suspected Acute Appendicitis

Robert Orth MD, PhD (Presenter): Grant, Toshiba Corporation Research support, General Electric Company, Sara Fallon: Nothing to Disclose, R. Paul Guillerman MD: Nothing to Disclose, Martha Mappus Munden MD: Nothing to Disclose, Wei Zhang PhD: Nothing to Disclose, George S. Bisset MD: Nothing to Disclose, Monica Lopez MD: Nothing to Disclose, Mary Brandt MD: Nothing to Disclose

PURPOSE

To facilitate consistent, reliable communication among providers, we developed a novel scoring system for reporting limited right lower quadrant ultrasound (US) exams obtained for suspected pediatric appendicitis. The purpose of this study was to evaluate implementation of this scoring system and its ability to risk-stratify children with suspected appendicitis.

METHOD AND MATERIALS

We developed a risk-stratification scale (Appy-Score) and structured reporting template for limited abdominal US exams obtained for suspected pediatric appendicitis. Appy-Score strata were: 1=normal completely visualized appendix; 2=normal partially visualized appendix; 3=non-visualized appendix, 4=equivocal; 5a=non-perforated appendicitis; 5b=perforated appendicitis. The Appy-Score was applied retrospectively to all limited right lower quadrant US exams ordered through our Emergency Department during a 5-month pre-implementation period (1/1/2013-5/31/2013), and Appy-Score use was tracked prospectively post-implementation (7/1/2013-9/30/2013). Diagnostic performance measures of US exams were computed post-implementation. Secondary outcomes included CT imaging following US exams and negative appendectomy rates.

RESULTS

We identified 1,235 patients in the pre- and 687 patients in the post-implementation groups. Appy-Score use increased from 24% in July to 89% in September (p=0.0001). The likelihood of appendicitis progressively increased with each score stratum. Sensitivity, specificity, positive predictive value and negative predictive value post-implementation were 93.8%, 92%, 83.8%, and 97.1%, respectively. The rate of CT imaging after US decreased from 8.6% pre-implementation to 5.9% post-implementation (p=0.048). Negative appendectomy rates did not significantly change (4.4% vs. 4.1%, p=0.88).

CONCLUSION

The use of a risk-stratified scoring system and standardized template for reporting the results of US exams for suspected pediatric appendicitis clearly communicated the likelihood of appendicitis to the treating physician and decreased the need for CT imaging. Future studies should assess whether this streamlines care in the emergency room setting and whether the risk strata are generalizable to other institutions with varying expertise in US imaging.

CLINICAL RELEVANCE/APPLICATION

A scoring system for reporting limited US exams performed for suspected pediatric appendicitis can risk-stratify patients and decrease the rate of follow-up CT imaging.

Definition of Normal Newborn Anorectal Anatomy by Ultrasound Using a Novel Posterior Approach

Ellen Christine Wallace MD (Presenter): Nothing to Disclose, Jean-Marc Gauguet MD, PhD: Nothing to Disclose, Jeremy Aidlen MD: Nothing to Disclose

PURPOSE

Describe the normal anatomy and characteristics of the anus, rectum, levator ani, puborectalis, ischiorectal fossa, sacrum and coccyx using a novel, posterior, trans-sacrococcygeal, high resolution ultrasound imaging
approach. Illustrate how to perform the technique and validate the information obtained by comparison with anatomic drawings and selected CT and MR images, which are more commonly used to evaluate this area.

METHOD AND MATERIALS

Retrospective review of images obtained as part of routine spinal ultrasound evaluations in newborns between 2005 and 2014. High resolution linear ultrasound probes were used via a trans-sacrococcygeal approach, in the posterior sagittal and axial planes with the infant prone. A series of images demonstrate rectum, anus, presacral space, levator ani, puborectalis, sacrum, coccyx and ischiorectal fossa. Review of CT and MR imaging data, obtained for unrelated reasons, has been used to corroborate, compare and contrast with the ultrasound imaging data.

RESULTS

The anal canal is particularly well seen by high frequency, linear, ultrasound probes, when evaluated from a posterior trans-sacrococcygeal approach in newborns. It has a characteristic cyclindrical appearance quite distinct from the rectum. The length, muscle thickness, anorectal ring, anal verge, and anorectal angle, are nicely depicted on sagittal images. The mucosa, internal and external anal sphincteric layers, and anorectal course through the levator ani muscles are well seen on axial images. The anal canal orientation with respect to rectum, sacrum, vagina and urethra can also be defined on the sagittal images. The integrity of the posterior sacrococcygeal elements is clearly seen. The images compare favorably with MR and CT of the same area without need for sedation or ionizing radiation in this young population.

CONCLUSION

Posterior, midline, trans-sacrococcygeal, high resolution, ultrasound imaging is a reproducible technique, which demonstrates normal anorectal and pelvic floor anatomy exquisitely well. Facility with this technique provides useful supplementary data to that obtained by transabdominal and transperineal ultrasound techniques.

CLINICAL RELEVANCE/APPLICATION

Confident demonstration and knowledge of normal ultrasound anorectal complex anatomy from a posterior approach provides a foundation to evaluate anorectal malformations, anterior ectopic anus and cloaca.

VSPD32-13  MRU: What Is Current Clinical Practice?

J. Damien Grattan-Smith MBBS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss key protocol aspects for MR urography in children to reproducibly generate high quality studies and show how MR urography is has widespread application in the evaluation of children with urinary tract disease.
LEARNING OBJECTIVES

1) Define Normalization of Deviance. 2) Discuss the History of Normalization of Deviance as it relates to NASA and health care in general. 3) Reflect on current practice and describe normalization of deviance as it is applied in imaging. 4) List negative consequence of normalization of deviance in imaging. 5) Explain ways that management can combat normalization of deviance in imaging.

ABSTRACT

As an imaging professional we are taught to be a patient advocate, to be technically competent and to have a patient safety mindset. Why is it then that often times we see “seasoned” imaging professionals taking shortcuts and exhibiting behaviors that don’t necessarily embody those characteristics? This lecture will explore “Normalization of Deviance” as a possible cause of this phenomenon. “Normalization of Deviance breaks the safety culture, substituting a slippery slope of tolerating more and more errors and accepting more and more risk, always in the interest of efficiency and on-time schedules.” (Prielipp, Mago, Morell and Brull, 2010) Simply, we take short cuts and veer from standards in the interest of patient flow and these short cuts become the norm because we don’t “see” any extreme negative outcome. Overtime, these new norms push the boundaries more and more. Normalization of Deviance theory has been applied to the Challenger space shuttle accident. Before the space shuttle blew up, O-ring erosion problems were documented numerous times. Over many occurrences and time, the engineers and managers started believing that these flaws were acceptable. This deviance became the new norm UNTIL the space shuttle accident. This lecture will discuss some of the new norms that may be becoming acceptable in imaging and possible negative outcomes. The role of management in combatting Normalization of Deviance will be explored. Reference: Prielipp, R. C. (2010-05). The Normalization of Deviance Do We (Un)Knowingly Accept Doing the Wrong Thing?. Anesthesia and analgesia, 110(5), 1499-1502. doi:10.1213/ANE.0b013e3181d5adc5

MSEC34

Case-based Review of Nuclear Medicine: PET/CT Workshop—Lymphoma/Melanoma/Sarcoma (In Conjunction with SNMMI) (An Interactive Session)

LEARNING OBJECTIVES

1) Discuss imaging presentation and special considerations when interpreting FDG PET/CT studies for lymphoma, melanoma and sarcoma. 2) Describe specific image appearance for tumor subtypes. 3) Formulate a systematic approach to interpreting PET/CT studies for this patient population. 4) Discuss pertinent correlative findings on CT for each diagnosis on a case by case basis.

ABSTRACT

MSEC34A

Asymmetries and Architectural Distortion - Challenging Mammographic Signs of Malignancy

LEARNING OBJECTIVES

1) Learn the definitions and types of asymmetries and architectural distortion identified at mammography. 2) Understand the imaging evaluation and clinical significance of asymmetries and architectural distortion identified at mammography. 3) Know the pathology correlation of asymmetries and architectural distortion identified at mammography.

ABSTRACT
Asymmetries and architectural distortion are challenging signs of malignancy at mammography.

**MSES34B**

**Image Guided Interventions**
Thomas Hans Helbich MD (Presenter): Research Grant, Medicor, Inc Research Grant, Siemens AG Research Grant, C. R. Bard, Inc

**LEARNING OBJECTIVES**
1) Identify the application of different image guided interventions in breast lesions. 2) Analyze image guided techniques and apply the knowledge to protocol development, patient management / safety, and costs. 3) Compare the indications, advantages, and controversies of imaging-guided interventions.

**MSES34C**

**Breast MRI: Non Mass Enhancement**
Steven P. Poplack MD (Presenter): Research Grant, Hologic, Inc

**LEARNING OBJECTIVES**
1) Become acquainted with the changes to the BIRADS lexicon that involve Non-Mass Enhancement in the BIRADS™ 5th edition. 2) Appreciate the range of appearances of Non-Mass Enhancement and the associated likelihood of malignancy of these different NME finding types. 3) Become familiar with the differential diagnosis of various types of Non-Mass Enhancement.

**ABSTRACT**
This presentation is intended to familiarize the audience with the range of appearances, differential diagnosis and likelihood of malignancy of the various forms of non-mass enhancement of the breast.

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**Hologic: 3D Breast Biopsy using the Selenia® Dimensions®, Affirm™ and Eviva® systems.**

**Vendor Workshops**
**Tue, Dec 2 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 www.hologic.com/RSNAtomo-courses to register for this Vendor Workshop.

**RC401**

**Contemporary Imaging of Lung Cancer**

**Refresher/Informatics**

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

**Tue, Dec 2 4:30 PM - 6:00 PM  Location: N230AB**

**Participants**
**Moderator**

Jeremy J. Erasmus MD : Nothing to Disclose

**Sub-Events**

**RC401A**

**Non-small Cell Lung Cancer Staging: Concepts and Controversies**
Joannis Vlahos MRCP, FRCP (Presenter): Research Consultant, Siemens AG Research Consultant, General Electric Company

**LEARNING OBJECTIVES**
1) Summarize the origins, basis and rationale of the current TNM classification of lung cancer. 2) Discuss the strengths and limitations of the current system and how to practically address these 3) Highlight areas where current radiology, oncological, surgical and pathological best practice and evolving knowledge in these area are progressing beyond the current staging system.

**RC401B**

**Contemporary Concepts in Small Cell Lung Cancer**
LEARNING OBJECTIVES

1) To learn the clinical manifestations, staging and prognostic factors of small cell lung cancer. 2) To become familiar with the role of PET-CT in the investigation and management of small cell lung cancer. 3) To review unusual presentations of small cell lung cancer and their investigation and treatment.

ABSTRACT

Small cell lung cancer, SCLC, accounts for approximately 15% of all lung cancers, with its overall incidence decreasing, although it is increasing in women, with the male to female incidence ratio now 1:1. Small cell lung cancer has a more rapid doubling time than non-small cell lung cancer, with most patients presenting with hematogenous metastases, and only approximately one-third presenting with limited-stage disease confined to the chest. Small cell lung cancer uncommonly presents with a solitary pulmonary nodule, and the disease does not appear to have benefited from Lung Cancer Screening. There are multiple neurologic and endocrine paraneoplastic syndromes associated with small cell lung cancer, with marked improvement on treatment of the underlying tumour. Historically SCLC was staged according to the Veteran's Administration Lung Group's 2 stage classification of 1) extensive-stage disease or 2) limited-stage disease, and this classification used to guide therapy. More recently it has been recommended that SCLC is staged according to the International Association for the Study of Lung Cancer (IASLC) and the AJCC Cancer Staging Manual 7th edition, using the same staging system for NSCLC and SCLC. Whilst contrast enhanced CT scan of the chest and abdomen remain routine as the initial method for staging SCLC, FDG PET-CT now plays a more important role in staging and management. SCLC is a highly metabolic disease, and PET-CT both upstages and downstages disease, potentially altering management.

PET Imaging of Lung Cancer: Beyond Standard Metabolic Assessment
Eric Michael Rohren MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review advanced image processing and metabolic parameters in FDG-PET/CT. 2) Discuss non-FDG radiotracers and their potential applications in non-small cell lung cancer. 3) Illustrate the role of advanced PET/CT in case examples.

ABSTRACT

Assessment of non-small cell lung cancer with PET is typically performed using F-18 fluorodeoxyglucose (FDG). The uptake and retention of FDG by the tumor is taken to be a measure of metabolism, which in turn can provide useful information on staging, grading, and prognosis. Advances in the field of PET/CT imaging may provide additional information for the evaluation and care of patients with lung cancer. Advanced semi-quantitative analyses including total lesion glycolysis (TLG) and metabolic tumor volume (MTV) have been employed to capture additional information from FDG-PET/CT studies, which in some cases is additive to standard metabolic parameters such as SUVmax. New tracers are under development, with some nearing approval in the U.S. and elsewhere. These include tracers targeting proliferation, receptor expression, and protein catabolism, investigating molecular events and processes beyond glucose metabolism.

MRI: Advances in Nodule Characterization and Lung Cancer Staging
Kyung Soo Lee MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review most popular MRI techniques that are used in thoracic MR imaging. 2) To demonstrate how effective MR imaging is in nodule characterization and lung cancer staging, particularly focused on diffusion-weighted imaging (DWI) and diffusion-weighted whole-body imaging with background body signal suppression (DWIBS).

ABSTRACT

Diffusion-weighted MR imaging helps characterize lung nodule, and enables staging and prognosis prediction in lung cancer. Diffusion-weighted whole-body imaging with background body signal suppression (DWIBS) is known to be specific in nodal staging and effective in whole body MR imaging. Both whole body MRI and PET-CT may be used in extra-thoracic lung cancer staging, but each modality has its own and different merits in lung cancer staging. Whole body MRI-PET may be the future oncologic imaging modality.

URL's

http://blog.naver.com/iks7629

CT Perfusion Imaging in Lung Cancer
Friedrich D. Knollmann MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To identify suitable indications for the use of CT perfusion imaging in lung cancer. 2) To apply CT perfusion imaging to lung tumors. 3) To recognize important features of a valid CT perfusion imaging protocol. 4) To interpret the results of a CT perfusion study in lung tumors.

**ABSTRACT**

CT perfusion (CTP) imaging has become a tenable proposition with the advent of multislice CT. Preliminary data have indicated a potential role in the assessment of treatment response in lung cancer, but the method is not widely used. In this course, the rationale for using CT perfusion imaging as a quantitative imaging biomarker in lung cancer is discussed. A review of CT protocols includes factors that have impeded a wider adoption of the method in the clinical sphere, such as the reproducibility of measurements, and validation efforts. Solutions to these problems, such as improved anatomic coverage with wider detectors and table motion, reduced radiation exposure with iterative reconstruction, advanced postprocessing with dual blood supply algorithms, motion registration and correction, and volumetric perfusion analysis are addressed. With these methods, tumor classification, assessment of tumor response, and prognostic testing are promising applications of CTP imaging.

**Thoracic Oncologic Imaging: Treatment Effects and Complications**

**Brett Wilson Carter MD** (Presenter): Author, Reed Elsevier Consultant, St. Jude Medical, Inc

**LEARNING OBJECTIVES**

1) Understand the role of imaging in the evaluation of patients who have been treated for thoracic malignancies. 2) Recognize the manifestations of radiation therapy in the chest and be able to differentiate expected changes from residual or recurrent disease. 3) Identify intrathoracic complications from radiation therapy, chemotherapy, and surgery.

**ABSTRACT**

Imaging plays an important role in the evaluation of patients who have been treated with radiation therapy, chemotherapy, and/or surgery for intrathoracic malignancies such as lung cancer, esophageal cancer, malignant pleural mesothelioma, and thymoma. Following thoracic radiation therapy, radiation pneumonitis (1-6 months following therapy) and radiation fibrosis (6-12 months following therapy) are typically identified in the lungs. However, complications such as esophagitis, esophageal ulceration, and radiation-induced cardiovascular disease may develop. Patients treated with chemotherapy may develop pulmonary and cardiovascular complications such as drug toxicity, organizing pneumonia, thromboembolic disease, vasculitis, and cardiomyopathy. Knowledge of the spectrum of expected treatment-related changes, potential treatment complications and the appearance of tumor recurrence is critical in order to properly monitor patients, identify iatrogenic complications, and avoid misinterpretation.
Sub-Events

RC403A  Standardized Reporting of Coronary CTA
Jill E. Jacobs  MD (Presenter):  Nothing to Disclose
LEARNING OBJECTIVES
1) To understand the advantages of standardized reporting. 2) To understand the components of a standardized cardiac CT report.

RC403B  Imaging and Interpreting Re-vascularized Coronary Arteries (I: Bypass Grafts)
Smita Patel  MBBS (Presenter):  Nothing to Disclose
LEARNING OBJECTIVES
1) To review the basic approach of evaluating coronary artery bypass grafts on CT. 2) To review normal surgical anatomy and pathology of coronary artery bypass graft conduits on CT.

RC403C  Imaging and Interpreting Re-vascularized Coronary Arteries (II: Stents)
Marc Dewey  MD (Presenter):  Research Grant, General Electric Company Research Grant, Bracco Group Research Grant, Guerbet SA Research Grant, Toshiba Corporation Speakers Bureau, Toshiba Corporation Speakers Bureau, Guerbet SA Speakers Bureau, Bayer AG Consultant, Guerbet SA Author, Springer Science+Business Media Deutschland GmbH Editor, Springer Science+Business Media Deutschland GmbH Institutional research agreement, Siemens AG Institutional research agreement, Koninklijke Philips NV Institutional research agreement, Toshiba Corporation
LEARNING OBJECTIVES
1) Review the issues involved in detecting coronary in-stent restenosis by CT angiography. 2) Get an overview of the diagnostic accuracy of CT angiography for coronary stents. 3) Understand the potential advantages of iterative reconstruction and perfusion assessment by CT for stents.

URL's
www.ct-kurs.de
Handout:Marc Dewey

RC403D  Deciphering Coronary Anomalies and Fistulas
Jonathan Dermot Dodd  MD (Presenter):  Nothing to Disclose
LEARNING OBJECTIVES
1) Review the basic classification of coronary anomalies and fistulas. 2) Understand the most clinically important anomalies and fistulas.

RC404  Hip Imaging: Challenges and Solutions

RC404A

RC404B

RC404C

RC404D

RC404E

RC404F
LEARNING OBJECTIVES

1) Multimodality imaging of the hip be reviewed, with an emphasis on MRI and MR arthrography.

Sub-Events

**Imaging and Treatment of the Snapping Hip**

Donna Genette Blankenbaker MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the causes of snapping hip. 2) Describe how to image snapping hip. 3) Discuss treatment options for the painful snapping hip.

**MoM Hip Complications**

Christian W. A. Pfirrmann MD, MBA (Presenter): Advisory Board, Siemens AG Consultant, Medtronic, Inc

LEARNING OBJECTIVES

1) To learn about the epidemiology and risk factors for complications after metal on metal hip implants. 2) To know the role of different imaging modalities for the diagnostic assessment of symptomatic metal on metal hip replacements. 3) To recognize the typical imaging findings symptomatic metal on metal total hip replacements.

ABSTRACT

In 2010 the Medicines and Healthcare products Regulatory Agency (UK) issued a Device Alert for certain metal on metal total (MoM) hip replacements: a small number of patients may develop progressive soft tissue reactions to metal wear. Data showed 5-year revision rate of approximately 12% on certain implants. Risk factors of MoM total hip arthroplasty (THA) are the use of large heads, hip resurfacings MoM THA with mal positioning (Cups with excessive anteversion/lateral inclination), high activity level of the patient, severe local / mechanical symptoms, change in gait (i.e. Limp), abductor weakness or swelling. Imaging workup of patients with MoM-THA should start with plain radiographs. Pseudotumors can be detected by US or MARS-MRI. A pseudotumor can be a solid or cystic mass, in continuity/communication with the hip joint. Pseudotumors are non-neoplastic and not infected. The majority of pseudotumors are associated with high wear. A minority of pseudotumors are associated with low wear and a prominent immune response. Two pathomechanism are discussed: Cytotoxic effect of phagocytosed metal particles on macrophages or a hypersensitivity response to metal wear particle. This leads to extensive necrosis and tissue destruction. Pseudotumors are not necessarily symptomatic. The presence of bone marrow edema and abductor tendon tears shows a higher correlation to symptoms than the presence or size of pseudotumors. Osteolysis is frequent, often undetected or underappreciated. Frequency of osteolysis in MoM hips similar to metal-on-polyethylene. However, early osteolysis is a concerning radiographic finding.

**Normal Anatomy, Variants and Pitfalls**

Ulrich Studler MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss a practical approach to the fundamentals of normal cross-sectional anatomy of the hip with a special emphasis on cartilaginous structures, the acetabular fossa, the location of bursae and their association with adjacent structures. 2) To know osseous and cartilaginous variants about the hip simulating disease. 3) To present pitfalls and skills to avoid misinterpretation of variants.

**Cam and Pincer Impingement: Acquired vs Developmental**

Stephen J. Pomeranz MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To present anatomic indications and differentiating features of cam vs pincer type hip impingement. 2) To review primary and secondary causes of hip impingement and considerations for measurement and assessment. 3) To discuss examples of acute, traumatic and developmental hip impingement on MRI with appropriate classification. 4) To identify imaging cues governing therapy.

**Traumatic Brain Injury**

Refresher/Informatics

Refresher/Informatics

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

Tue, Dec 2 4:30 PM - 6:00 PM   Location: E451A
LEARNING OBJECTIVES

1) To assess patients with acute head trauma through the use of a standardized imaging pattern analysis approach. 2) To become familiar with the different types of traumatic brain injury and their imaging patterns. 3) To learn about the imaging characteristics of various types of intracranial haemorrhage by CT and MR. 4) To identify quantitative imaging parameters that can serve as (surrogate) biomarkers for predicting patient prognosis and outcome.

ABSTRACT

CT and MRI examinations constitute an essential part of the diagnostic work-up of patients with head trauma. In the acute setting, imaging findings determine patient management and greatly influence the clinical course. CT remains the first choice technique to determine the presence and extent of injuries, and to guide surgical planning. Multi-detector CT allows simultaneous assessment of head and cervical spine, obviating the need for plain X-rays. A standardized pattern analysis approach will be presented, to obtain a complete inventory of the traumatic brain lesions. From a clinical point of view, it is important to understand the difference between primary and secondary lesions. Primary injuries occur as a direct result of the impact with damage to brain tissue. Examples include fractures, different types of traumatic haemorrhage (epidural, subdural, intracerebral, subarachnoid), cerebral contusion, diffuse axonal injury (DAI). CT-angiography is useful to document traumatic blood vessel injury. Secondary injuries are caused by systemic factors such as increased intracranial pressure, edema, brain herniation, decreased cerebral blood flow, excitotoxic damage. These lesions can be documented with multiparametric MRI including diffusion, perfusion, and susceptibility-weighted imaging. Whenever there is a discrepancy between the patient’s clinical status and imaging findings, MRI is indicated. Diffusion tensor imaging with fractional anisotropy mapping may show microstructural abnormalities in patients with mild TBI, even when traditional MRI sequences appear normal. Neuroimaging also plays a role in the chronic stage, identifying sequelae, determining prognosis, and guiding rehabilitation. In conclusion, recent technological advances in CT and MRI have greatly improved our understanding of the pathophysiology of craniocerebral trauma and allow us to detect abnormalities, even in patients with mild head trauma, when routine imaging studies appear normal.
The temporal bone is a small but anatomically complex region for which the acquisition of a basic knowledge of anatomy represents a significant achievement. Review of temporal bone imaging studies requires a highly structured and systematic approach, in order to prevent missing important but often subtle imaging findings. Additionally, good imaging technique is critical, and time spent optimizing protocols will yield substantial dividends. Currently, one should interpret studies with submillimeter acquisition and reconstruction thicknesses, with the right and left sides reconstructed separately at small field of views. A minimum of axial and coronal planes should be reviewed; many additionally interpret sagittal images, with oblique planes available to aid in specific diagnostic issues, such as superior semicircular canal dehiscence. Inflammatory disease of the temporal bone can be broadly divided into acute and chronic processes; these differ not only in duration of disease, but most importantly, in etiology. Acute otitis media represents an infection that typically ascends from the upper respiratory tract and is most common in children. Chronic otomastoiditis is a result of Eustachian tube dysfunction and is typically not associated with infection. Both are imaged primarily to look for complications, as the primary diagnosis is made clinically. A wide variety of tumors affect the temporal bone, including those found elsewhere intracranially and at the skull base, including meningioma, schwannoma and paraganglioma. The skin of the external auditory canal is susceptible to those lesions that may affect skin anywhere, including squamous and basal cell carcinomas, as well as melanoma. Other tumors, such as metastases, myeloma and lymphoma, are primary to the osseous components of the temporal bone and are most commonly found at the petrous apex.

**Sub-Events**

**Temporal Bone Imaging: Anatomy**
Tabassum A. Kennedy MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
1) Analyze the temporal bone using a systematic approach. 2) Identify the main structures of the temporal bone based on anatomic location within the external ear, middle ear and inner ear.

**Temporal Bone Imaging: Inflammation**
Deborah Rachelle Shatzkes MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
1) To recognize CT and MRI imaging anatomy of the temporal bone most salient to temporal bone disease. 2) To apply an understanding of the etiologic differences between acute and chronic inflammatory disease of the temporal bone to the interpretation of relevant imaging studies. 3) To analyze CT and MRI imaging features and construct a limited and clinically relevant differential diagnosis for temporal bone masses.

**Active Handout**

**Temporal Bone Imaging: Tumor**
Karen Lisa Salzman MD (Presenter): Consultant, Amirsys, Inc Stockholder, Amirsys, Inc

**LEARNING OBJECTIVES**
1) Review the benign and malignant tumors of the temporal bone. 2) Understand the key imaging features of each tumor in order to differentiate the lesions in clinical practice.

**Abdominal Incidentalomas: What to Report for Adrenal, Renal and Adnexal Incidental Findings**

**Refresher/Informatics**

**AMA PRA Category 1 Credits ™**: 1.50  
**ARRT Category A+ Credits**: 1.50  
**Tue, Dec 2 4:30 PM - 6:00 PM**  
**Location**: N227AB

**Participants**
William W. Mayo-Smith MD (Presenter): Author with royalties, Reed Elsevier  
Gary M. Israel MD (Presenter): Nothing to Disclose  
Genevieve Louise Bennett MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
1) Appreciate the scope and nature of the problem of abdominal incidental findings and the implications of the results of a survey of ACR membership on this topic. 2) Better understand the complexities of managing small renal cystic and solid masses, including when and how long to follow suspicious lesions. 3) Be able to apply criteria for diagnosing and following incidental adrenal lesions, including when and how to reference the new guidelines. 4) Understand how to apply the new ACR recommendations for incidental ovarian findings seen on CT and MRI and their relationship to the Society of Radiologists in Ultrasound consensus criteria for such findings.
**Blood on the Brain: Intracranial Hemorrhage in the Emergency Setting (An Interactive Session)**

*Refresher/Informatics*

**Sub-Events**

**RC408A**  
**Traumatic Intracranial Hemorrhage**  
Wayne Scott Kubal MD (Presenter): Stockholder, Stryker Corporation Research Grant, Guerbet SA  

**LEARNING OBJECTIVES**

1) Understand how pathophysiology and anatomy determine the imaging appearance of traumatic intracranial hemorrhage.  
2) Critically assess which imaging options offer the greatest sensitivity for diagnosing traumatic intracranial hemorrhage.  
3) Be conversant with some of the new techniques for studying traumatic intracranial hemorrhage.

**RC408B**  
**Non-traumatic Subarachnoid Hemorrhage**  
Diego B. Nunez MD, MPH (Presenter): Nothing to Disclose  

**LEARNING OBJECTIVES**

1) Analyze the various causes, patterns of distribution and imaging features of non-traumatic subarachnoid hemorrhage.  
2) Identify common and not so common diagnostic pitfalls encountered in the initial CT assessment of the patient with suspected subarachnoid hemorrhage.  
3) Recognize the contribution of additional imaging (CT angiography, MR, DSA) as integral part of the admitting evaluation of patients with subarachnoid hemorrhage.

**RC408C**  
**Non-traumatic Intraparenchymal Hemorrhage**  
Peter George Kranz MD (Presenter): Research Consultant, Cephalogics, LLC  
Research Consultant, Biogen Idec Inc  

**LEARNING OBJECTIVES**

1) Identify the major causes for non-traumatic (spontaneous) brain parenchymal hemorrhage.  
2) Understand the role of the primary survey in indentifying the most important imaging features needed for the acute management of hemorrhages.  
3) Understand the contribution on non-contrast CT, CTA, and MRI in the management of spontaneous hemorrhage, including the contribution these modalities make to defining the etiology of hemorrhages.

**RC409**

**Interactive Game: Gastrointestinal - Abdominal Masses**

*Refresher/Informatics*

**Participants**

Jay P. Heiken MD (Presenter): Patent agreement, Covidien AG  
Patent agreement, Bayer AG  
Erik K. Paulson MD (Presenter): Nothing to Disclose  
Zhen Jane Wang MD (Presenter): Nothing to Disclose  
David Joseph Disantis MD (Presenter): Nothing to Disclose  

**LEARNING OBJECTIVES**

1) Learn the characteristic features of some common and atypical abdominal masses.  
2) Understand how newer techniques, such as gadoxetate-enhanced MRI and diffusion-weighted imaging, help to identify and characterize abdominal masses.  
3) Identify the key imaging findings that assist surgeons or oncologists treating specific abdominal masses. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.
Renal Ultrasound and Doppler (An Interactive Session)

**Refresher/Informatics**

VA US GU

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

Tue, Dec 2 4:30 PM - 6:00 PM   Location: E450B

Sub-Events

**Masses and Parenchymal Diseases**

Michael David Beland MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify the imaging features of a variety of etiologies of renal masses and understand the potential overlap between malignancy, non-malignant mass-like lesions and pseudomasses. 2) Recognize the potential limitations of ultrasound in the identification of renal masses and learn to maximize technique. 3) Demonstrate the wide range of appearances of parenchymal diseases on ultrasound and develop an approach to evaluation.

**ABSTRACT**

Renal masses are a common finding on ultrasound. While the vast majority are cysts, solid appearing lesions are also frequently encountered. Not all 'masses' are cancer and there are numerous mimickers of malignancy on renal ultrasound. Numerous cases will be shown of various malignant and non-malignant etiologies of renal masses. Factors impacting the sensitivity of renal ultrasound for detection of masses will be reinforced. Finally, renal parenchymal diseases can demonstrate a wide variety of sonographic appearances. Multiple examples will be shown as well as the importance of developing a systematic evaluation of the patient with parenchymal disease.

**Renal Doppler**

John Stephen Pellerito MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Learn techniques and protocols for Doppler evaluation of the renal arteries. 2) Optimize abdominal Doppler studies. 3) Recognize the role of Doppler in evaluation of renal stents.

**ABSTRACT**

Evaluation of the renal arteries and kidneys is an integral component of the workup of renal insufficiency and hypertension. Doppler ultrasound examination is proven valuable in the detection of renal artery stenosis and occlusion. Doppler ultrasound has multiple advantages over CT or MR angiography: noninvasive, no radiation and does not require administration of contrast material. This program will discuss the techniques and protocols needed for successful renal artery evaluation with Doppler ultrasound. Tips to optimize the examination will be provided. There will also be a discussion of the evaluation of renal artery stents.

**Renal Transplants**

Deborah J. Rubens MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the normal parenchymal and vascular anatomy of renal transplants including their normal Doppler parameters. 2) Identify the most common causes of renal transplant complications and criteria for their diagnosis. 3) Outline some of the pitfalls in transplant ultrasound imaging and when to use CT, MR and/or angiography in addition to ultrasound.

**ABSTRACT**

This lecture will review the anatomy and pathophysiology of renal transplants. The role of ultrasound imaging in assessment of acute as well as chronic renal transplant dysfunction will be elucidated. The performance of Doppler ultrasound will be highlighted regarding vascular stenosis and occlusion, parenchymal perfusion, and planning and assessing organ biopsy. Doppler techniques to avoid false negative and false positive studies will be emphasized. Controversial parameters will be stressed, in particular the use of absolute velocities versus ratios in the diagnosis of renal artery stenosis. Surgical emergencies will be highlighted, and the role of correlative imaging with CT, MR and/or angiography will be addressed.

**Active Handout**

Learning Objectives

1) Understand the technical advancements associated with new scintillation cameras and SPECT-CT and PET-CT cameras. 2) Appreciate the benefits of CT attenuation correction. 3) Appreciate the adjunctive benefits of anatomic definition provided with CT and physiologic/function information provided by SPECT and PET. 4) Improve interpretive skills related to SPECT and PET-CT.

Abstract

Camera and software technology recently has rapidly advanced, providing improved SPECT image resolution and increased counting statistics. These advancements in turn have provided the possibility of reduced-time and reduced radiopharmaceutical dose image acquisitions. Moreover, increased flexibility in imaging protocols has been realized. Future development of these methods hold promise in increasing diagnostic accuracy and expanding diagnostic applications. The addition of CT to SPECT and PET has afforded the ability to perform attenuation correction, thereby minimizing attenuation artifacts and increasing diagnostic specificity. With CT acquisitions of sufficient resolution, complementary anatomic diagnostic information is provided. In addition, more precise anatomic localization of SPECT and PET abnormalities significantly increases clinical applicability.

Sub-Events

RC411A Advances in Cardiac SPECT

E. Gordon Depuey MD (Presenter): Consultant, BioClinica, Inc Consultant, ICON plc Steering Committee, Adenosine Therapeutics, LLC

Learning Objectives

1) Understand software methods to cope with lower SPECT counting statistics in order to reduce scan acquisition time and/or radiopharmaceutical injected activity and their clinical impact. 2) Understand instrumentation advances that allow new cameras to perform SPECT with markedly reduced acquisition times and/or less radiopharmaceutical activity and their clinical impact. 3) Implement protocols that facilitate patient-centered imaging and that reduce patient radiation exposure. 4) Recognize new software methods to select appropriate patients for cardiac resynchronization therapy (CRT).

Abstract

New software methods and new innovative hardware now allow for significantly shortened SPECT acquisition times without a decrease in image quality. Advancements include iterative reconstruction, resolution recovery, and noise reduction software, and focused collimation and solid state detectors incorporated into new camera designs. Attenuation correction increases diagnostic specificity and facilitates stress-only protocols. Software advancements such as high resolution imaging, scatter correction, and respiratory gating increase diagnostic sensitivity. There has been an intersocietal effort to promote patient-centered imaging with a focus on appropriateness guidelines, cost-containment, radiation dose reduction, and the selection of the most appropriate imaging test and protocol to suit particular patient needs. The technical advancements described above facilitate implementation of patient-centered imaging. Even with such technical advancements, however, attention to technical detail is essential to assure optimal image quality. Camera and radiopharmaceutical quality control deserve the highest priority. A systematic review of myocardial perfusion SPECT images is essential to recognize artifacts and optimize diagnostic accuracy. Case examples will be presented to reinforce this approach.

RC411B Advances in Cardiac PET

Sharmila Dorbala MBBS (Presenter): Research Grant, Astellas Group Speaker, General Electric Company

Learning Objectives

1) Review the advantages and disadvantages of myocardial perfusion PET compared to SPECT for evaluation of coronary artery disease. 2) Learn the added value of absolute quantitative parameters derived from PET for assessment of cardiovascular disease. 3) Update of current and future clinical applications of cardiac PET imaging in cardiovascular medicine.

RC412 Thoracic Aorta: Key Concepts (An Interactive Session)
**LEARNING OBJECTIVES**

1) Discuss Pathophysiology and Prevalence of Symptomatic Severe Aortic Stenosis. 2) Discuss Transcatheter Treatment Options (TAVR). 3) Discuss Critical Role of Imaging in the Context of TAVR.

**ABSTRACT**

If left untreated, symptomatic, severe aortic stenosis (AS) is associated with a dismal prognosis. Open-heart surgical valve replacement is the treatment of choice and is associated with excellent short and long-term outcome. However, many older patients with multiple co-morbidities and anticipated increased surgical risk are excluded from surgical intervention. For these patients, transcatheter aortic valve implantation (TAVI) is emerging as a viable treatment alternative. Transcatheter valvular heart procedures are characterized by lack of exposure and visualization of the operative field, therefore relying on image guidance, both for patient selection and preparation and the implantation procedure itself. This article describes the role of multi-detector row computed tomography (MDCT) for detailed assessment of the aortic valve, aortic root, and iliac arteries in the context of TAVI.

**URL's**

http://www.thecdt.org/article/view/1583/3023

Handout: Paul Schoenhagen

http://media.rsna.org/media/abstract/2014/13011995/TAVR cloud.pdf

**LEARNING OBJECTIVES**

1) Review the pathology, epidemiology, and natural history of acute type A aortic dissection. 2) Describe the imaging strategies and diagnostic information sought in patients with acute aortic syndromes. 3) Review the recent classification of acute aortic dissection. 4) Illustrate imaging findings of the spectrum of acute type A aortic dissection, with a focus on recognizing subtle CT angiographic findings related to the lesser known ‘Class 3’ aortic limited intimal tear or limited dissection.

**ABSTRACT**

The traditional Stanford classification distinguishes between dissections involving the ascending aorta (Type A) from those that do not involve the ascending aorta (Type B). Type A aortic dissection is rare, but remains the most lethal of aortic disorders requiring prompt surgical intervention. The common pathologic denominator in patients with acute dissection is an abnormal aortic media (‘cystic medial necrosis’) which can be found in genetic/inherited diseases (e.g. Marfan’s) but also in patients with severe hypertension. The CT imaging strategy of suspected acute aortic syndrome should always include (i) non-enhanced images to assess for intramural hematoma (IMH); when the index of suspicion for aortic dissection is high, also consider (ii) EKG-gating for motion-free evaluation of the aortic root/ascending aorta, and (iii) including common femoral arteries in the CTA scan range to assess lesion extent and identify a percutaneous access route. The spectrum of aortic dissection has recently been classified as the following: Class 1 classic dissection with true and false lumen separated by an intimal flap; Class 2 IMH; Class 3 discrete or limited dissection; Class 4 penetrating atherosclerotic ulcer (PAU); and Class 5 iatrogenic/traumatic. A clarification and modified conceptual classification of aortic dissection will be provided, along with illustrative examples of these aortic lesions. Particular focus will be given to the lesser known Class 3 ‘limited intimal tear’ which is described as a subtle and eccentric bulge of the aortic wall. While it has been reported to elude current imaging techniques, emphasis will be made on recognizing subtle CTA imaging findings characteristic of this uncommon but important dissection variant.

**LEARNING OBJECTIVES**

1) Describe common indications for surgical intervention in thoracoabdominal aortic disease including aneurysm, vasculitis, infection, trauma and connective tissue disorders. 2) Identify key CTA features of the normal postoperative aorta. 3) Present the characteristic CTA findings for complications of postoperative aortic repair including disease progression, thrombosis, stenosis, infection, pseudoaneurysm, aorto-enteric fistula and aortic rupture.

**ABSTRACT**

Surgical procedures and complications of the thoracoabdominal aorta
**RC414**

**Venous Disease**

*Refresher/Informatics*

**Participants**
- Anne C. Roberts MD (Presenter): Researcher, Elbit Imaging Ltd Research Consultant, Guerbet SA Research Consultant, General Electric Company
- Gerant M. Rivera-Sanfeliz MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Decide on the appropriate patients to undergo venous ablation. 2) Know various tools used for venous ablation. 3) Understand some of the issues of large vein occlusions and possible treatments. 4) Gain familiarity with the presentation pelvic congestion and varicocele. 5) Have a familiarity with the treatment of pelvic congestion and varicoceles.

**ABSTRACT**

Lower leg varicosities are a very common problem. Over the last 10 years there has been increasing interest in the percutaneous treatment of varicosities. The patient population with varicosities, the presentation of varicosities, and the treatment of varicosities will be presented. Other venous anomalies can worsen the symptoms of varicosities and may need to be treated. These include May-Thurner syndrome, pelvic congestion, and the male variant of pelvic congestion syndrome (varicoceles). The patient population, symptoms and presentations, and the treatment of these other venous abnormalities will also be discussed.

**Active Handout**

http://media.rsna.org/media/abstract/2014/13010573/RC414 Sec.pdf

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**RC415**

**Clinical Breast MR Imaging (An Interactive Session)**

*Refresher/Informatics*

**Sub-Events**

**RC415A**  
**Tips on Interpretation**
- Constance D. Lehman MD, PhD (Presenter): Consultant, Bayer AG Consultant, General Electric Company Research Grant, General Electric Company

**LEARNING OBJECTIVES**

1) Develop skills in distinguishing suspicious lesions from background enhancement. 2) Use the BI-RADS lexicon to accurately assess breast lesions and provide final interpretation.

**RC415B**  
**MR BI-RADS 3**
- Christopher E. Comstock MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand appropriate use of the ACR BI-RADS 3 in MR Interpretation. 2) Review case examples of when and when not to use BI-RADS 3 classification.

**RC415C**  
**Challenging Cases**
- Gillian Maclaine Newstead MD (Presenter): Medical Advisory Board, Bayer AG Consultant, Three Palm Software LLC Consultant, VuCOMP, Inc Medical Advisor, Quantitative Insights, Inc

**LEARNING OBJECTIVES**

1) To review the analysis of enhancing lesions on breast MRI. 2) To identify features useful in distinguishing benign from malignant. 3) To discuss common pitfalls in breast MRI interpretation.
Radiology Education in Developing Nations: A Focus on Needs and Support in Latin America and Asia Oceania Regions (Sponsored by the RSNA Committee on International Radiology Education)

Sub-Events

**RC416A**
**Introduction and Overview of CIRE Programs**
Teresita L. Angtuaco MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
1) To discuss the ongoing international educational programs sponsored by the RSNA through the Committee on International Radiology Education. 2) To review the updated accomplishments of the CIRE programs around the world. 3) To explain the eligibility criteria and method of applications for each educational program.

**RC416B**
**Educational Needs in Latin America**
Manoel Souza Rocha MD, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
1) Recognize the different levels of development of Radiology in Latin America. 2) Comprehend the specifics of teaching Radiology to medical students and residents in Latin America. 3) Identify what can be done to improve radiological education in Latin America.

**ABSTRACT**
Radiology in Latin America presents peculiarities arising from different levels of economical and social development of the countries. Some areas have a degree equivalent to the development of European and North American countries, while in others it is very restricted the access to diagnostic imaging. These disparities are repeated in the educational area. Educational programs in Radiology for Latin America necessarily need to contemplate these disparities, as in some areas it is necessary to develop advanced research programs and in others the radiological societies must invest primarily in improving teaching basic radiology.

**RC416C**
**Available Educational Support in Latin America**
Gloria Soto Giordani MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
1) Describe local radiological educational resources available within Latin American countries. 2) Identify radiological educational resources offered to Latin American Countries by regional, continental and global radiological societies and organizations 3) Analyze the impact of these resources in radiological training programs and continuous medical education of radiologists as perceived by local leaders

**ABSTRACT**
Latin America comprises 20 countries with a total of over 585 millions inhabitants. The region is characterized by vast differences among countries not only in ethnical, political, economical, cultural and social aspects, but also healthcare issues, including radiological practice and education. Even if regional and global radiological societies often offer educational resources in an open way, the advantage taken by different countries of these opportunities is not homogeneous due to differences in access to international networks. Harmonization of radiological education in Latin America is essential to improve radiological practice in the region. To achieve this it is mandatory to strengthen local educational resources and also to allocate educational resources of regional /global organizations to countries that need it the most.

**RC416D**
**Educational Needs in Asia/Oceania**
Chamaree Chuapetcharasopon MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
1) Recognize the diversities of the Asia/Oceania region in term of geographic, demographic, ethnic, cultural, socioeconomic, linguistic and educational differences in the region. 2) Understand the gaps in radiological
education, numbers of radiologists and practices among countries in the region. 3) Identify the needs for radiological education and training in the region.

ABSTRACT

Asia/Oceania comprises of two continents. There are more than 70 countries in Asia/Oceania region. The estimated population for Asia in 2014 is 4,426,683,000. The Population in Oceania is approximately 39,000,000. The most populated country is the People's Republic of China with an estimated population of 1.39 billion people. The numbers of radiologists also vary from country to country. China has more than 30,000 radiologists. Australia in 2012 has approximately 1700 radiologists. The ratio of radiologists per million population in Australia is 77.6 per million while in Indonesia the ratio is 3 per million. The residency training program in Australia is 5 years while the length of residency training in China depends on the training hospital and previous clinical experience of the trainee. There are different needs for radiological education and training in the region. To identify those needs, cooperation among the countries in the region is the key.

Available Educational Support in Asia/Oceania

Jeong Min Lee MD (Presenter): Research Grant, Guerbet SA Equipment support, Siemens AG Research Grant, Bayer AG

LEARNING OBJECTIVES

1) Understand the organization, and characteristics of several asian/oceanian radiological societies. 2) Review why increasing educational support in Asia/Oceania is important. 3) Learn what resources are available for radiologists concerning education regarding recent technologies of Radiology. 4) Discuss potential sources of available educational support for radiology in Asia/Oceania.

Response from RSNA

Teresita L. Angtuaco MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To assess educational needs and existing support for radiologists in Latin America and Asia Oceania. 2) To evaluate areas of collaboration between RSNA, AOCR and ICR in improving radiology education 3) To propose solutions for perceived educational needs in Latin America and Asia Oceania through existing RSNA international educational programs.

Novel Applications of Dual Energy CT

Refresher/Informatics

CT

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

Tue, Dec 2 4:30 PM - 6:00 PM Location: S504CD

Participants

Moderator
Myrna Cobos Barco Godoy MD, PhD: Nothing to Disclose

Sub-Events

RC417A

Dual-Energy CT: Thoracic Applications

Myrna Cobos Barco Godoy MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To comprehend the basic physical principles of dual-energy CT (DECT). 2) To review the current clinical potential applications of DECT in thoracic imaging.

ABSTRACT

There are different methods by which dual-energy CT images can be generated. The advantages of DECT technique are twofold: 1) Low kilovoltage imaging with increased iodine conspicuity (based on increased photoelectric interactions) is especially useful for evaluation of vascular structures. 2) Material specific post-processing allows material differentiation (based on the differential CT attenuation of selected substances at two different energies), which can be tailored for each particular clinical indication, for example to evaluate for contrast enhancement in pulmonary nodules. The current potential clinical applications of DECT in thoracic imaging include evaluation of pulmonary arteries, aorta, pulmonary nodules, pleural masses and airways disease.
New Insights on Dual Energy CT in Oncology

Carlo Nicola de Cecco MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the basic principles of DECT imaging. 2) To explain how post-processing is practised. 3) To discuss radiation exposure issues. 4) To critically appraise the strengths and weaknesses of the technique in oncologic imaging. 5) To comment on the contribution of DECT imaging in oncologic patients management.

ABSTRACT

Dual Energy CT (DECT) is an innovative imaging technique, whose basic principle is the application of two distinct energy settings making able to distinguish materials with different molecular composition on the basis of their attenuation profiles and thus operating a transition from density based image to spectral imaging. DECT applications are based on two distinct capabilities: 1) material differentiation, which means achieving material-specific imaging with separation of distinct materials, for example iodine, calcium, and uric acid, within an image obtained during a single examination and 2) material identification and quantification, which means accurate assessment of the presence and amount of iodine within a target lesion. In particular, with DECT acquisition multiple data-sets such as elemental decomposition analysis, iodinated density map, monochromatic images or virtual unenhanced images can be obtained simultaneously making the Radiologist able to address different diagnostic problems and improving lesion detection and characterization. These technical characteristics make DECT an innovative imaging modality particularly useful in oncologic imaging, having clear advantages in tumor detection, lesion characterization, evaluation of response to therapy, and detection of oncologic-related disease. In conclusion, DECT represents an innovative imaging technique, which can significantly impact on the management of oncologic patients.

Musculoskeletal Imaging with DECT

Savvas Nicolaou MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review the technique and principles of DECT and spectral imaging as it pertains to the musculoskeletal application. 2) Demonstrate the musculoskeletal applications of DECT/spectral imaging in musculoskeletal imaging with an emphasis on the ability to diagnose and monitor progression of gout. 3) Display additional abilities and demonstrate imaging examples of DECT/spectral imaging for identification of bone marrow edema, soft tissue (tendon and ligamentous) injuries, and reduction of metal artifacts. 4) Review the advantages and limitations of DECT compared to other imaging modalities for musculoskeletal imaging.

ABSTRACT

Dual energy CT and Spectral imaging are useful tools for musculoskeletal imaging. We will focus on the utility of this in the setting of musculoskeletal imaging of gout by demonstrating its ability to aid in diagnosis in challenging cases, delineate anatomy of crystal deposition disease, and monitor disease progression and treatment of the monosodium urate crystals. The audience will learn the utility of DECT/Spectral imaging for additional musculoskeletal applications such as characterization of acute bone marrow edema, identification of tendon and ligamentous injuries and reduction of metal artifacts using monoenergetic imaging.
ABSTRACT

Two common descriptors are used in describing pulmonary lesions: nodules and masses. A nodule is small and measures less than 3 cm. Masses by definition are larger than 3 cm. Given their larger size, masses are usually not as difficult to detect as are the smaller nodules. But once detected, the differential diagnosis entails more than just primary pulmonary malignancy, although the majority may end up being diagnosed as cancer. Tissue sampling of large masses is usually one of the first steps, but several imaging criteria may help guide and sometimes even obviate invasive procedures. The chronicity, location of the mass and associated symptoms are important factors that should always be taken into consideration when evaluating pulmonary masses, only to name a few.

Abdominal Masses

Chandana G. Lall MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Learn typical and atypical features of some benign and malignant abdominal masses on CT and MRI. 2) Characterize features on CT and MRI that may mimic malignancy in benign lesions and vice versa. 3) Discuss logical work-up of lesions, further imaging, need for intervention and follow-up guidelines.

ABSTRACT

1. Describe characteristic imaging features of a few benign and malignant abdominal masses on CT and MRI. 2. Illustrate benign masses that may mimic malignancy and imaging pitfalls in differentiating benign and malignant lesions. 3. Logical work up of lesions; further imaging and need for intervention.

MSK/Soft Tissue Masses

Sandra Schmahmann MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize common benign soft tissue masses with characteristic MRI features, that do not require follow up or biopsy. 2) Evaluate soft tissue masses by location, signal intensity characteristics, size and relationship to certain anatomic structures in order to develop a differential diagnosis. 3) Suggest appropriate management of the soft tissue mass based on MRI features.

ABSTRACT

Several common benign soft tissue masses, such as lipoma, hemangioma, ganglion, peripheral nerve sheath tumor, myositis ossificans and hematoma, have characteristic MRI features that allow the radiologist to make the diagnosis, and do not require follow up or biopsy. Lesions that arise from specific structures (e.g. giant cell tumor of the tendon sheath and peripheral nerve sheath tumor) or in certain anatomic locations (e.g. elastofibroma deep to the scapula) can further aid characterization. Size and signal intensity characteristics are additional criteria that help develop an appropriate differential diagnosis. Based on MRI features, the radiologist can suggest appropriate management and advise whether a biopsy is necessary.

Role of Stereotactic Ablative Radiotherapy (SABR) and Interventional Radiology in the Management of Oligometastases

Refresher/Informatics

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

Tue, Dec 2 4:30 PM - 6:00 PM  Location: S403A

Participants

Moderator
Simon Shek-Man Lo MD: Research support, Elekta AB Speaker, Varian Medical Systems, Inc Travel support, Varian Medical Systems, Inc

LEARNING OBJECTIVES

1) Understand the role, eligibility criteria, expected treatment outcomes and toxicities of stereotactic ablative radiotherapy (SABR) for lung oligometastases. 2) Understand the role, eligibility criteria, expected treatment outcomes and toxicities of SABR for liver oligometastases. 3) Understand the role, eligibility, expected outcomes and toxicities of SABR for spinal oligometastases. 4) Understand the role of interventional radiology in the management of oligometastases.

ABSTRACT

It has been a notion that once distant metastases occur, cancer is typically widely disseminated. Hellman and Weichselbaum from University of Chicago have proposed the state of oligometastasis where the metastatic disease is limited in number and site. There is clinical evidence to suggest that local aggressive therapy such as surgical resection may prolong survival and may even achieve a cure. Most recently, non-surgical therapies such as stereotactic ablative radiotherapy and image-guided ablative therapies for oligometastases have emerged, appearing to yield promising results based on multiple retrospective studies and single arm clinical trials. There are certainly controversies with regard to the use of local aggressive therapies for
oligometastases. To establish this strategy as the standard of care for oligometastasis, a randomized controlled trial comparing conventional care and local aggressive therapy would be ideal. The potential toxicities associated with these therapies have to be seriously considered before offering them to patients. Currently, there is an ongoing international randomized trial comparing SABR and conventional treatment enrolling patients in Canada and Europe and the results of this trial are eagerly awaited.

Sub-Events

SABR for Lung Oligometastases

Simon Shek-Man Lo MD (Presenter): Research support, Elekta AB Speaker, Varian Medical Systems, Inc
Travel support, Varian Medical Systems, Inc

LEARNING OBJECTIVES

1) To appreciate the technical requirements for lung SABR. 2) To appreciate the current outcomes for local control and survival. 3) To appreciate the challenges in response assessment. 4) To appreciate the toxicities associated with lung SABR.

ABSTRACT

There is clinical evidence to suggest that local aggressive therapy such as surgical resection may prolong survival and may even achieve a cure in selected patients with lung oligometastasis. Stereotactic ablative radiotherapy (SABR) has emerged as an alternative treatment option for lung oligometastases and promising results have been observed in multiple retrospective studies and single arm clinical trials. More research is needed to better define the role of SABR in the management of lung oligometastasis.

SABR for Liver Oligometastases

Michael Lock MD (Presenter): Research Consultant, Accuray Incorporated

LEARNING OBJECTIVES

1) Discuss the reason primary and secondary liver cancer will become an important and growing proportion of patients seen in your clinic. 2) Review the rationale and outcome for radiotherapy in oligometastatic disease. 3) Compare the various methods to treat liver lesions in terms of evidence, outcome and practicality. 4) Understand the problems and solutions for motion management and image-guidance in this area. Review the options and selection of technology 5) Understand why we need to be aware of new toxicities and safety parameters.

ABSTRACT

ID: 20130102 (Track 20) Title: SABR for Liver Oligometastases The learner will be able to: 1. discuss the reason primary and secondary liver cancer will become an important and growing proportion of patients seen in your clinic. 2. review the rationale and outcome for radiotherapy in oligometastatic disease 3. compare the various methods to treat liver lesions in terms of evidence, outcome and practicality 4. understand the problems and solutions for motion management and image-guidance in this area. Review the options and selection of technology 5. understand why we need to be aware of new toxicities and safety parameters.

SABR for Spinal Oligometastases

Arjun Sahgal (Presenter): Speaker, Medtronic, Inc Speaker, Elekta AB

LEARNING OBJECTIVES

1) To appreciate the technical requirements for spine SABR. 2) To appreciate the current outcomes for local control. 3) To appreciate the challenges in response assessment. 4) To appreciate the toxicities associated with spine SABR.

ABSTRACT

The aim of this session is to describe the technical requirements for spine SABR and to review outcomes for spinal metastases. The current challenges in response assessment will be reviewed and the effort to standardize response criteria. Lastly, there are several serious late toxicities that can result from spine SABR and these will be reviewed.

Interventional Radiology in the Management of Oligometastases

Sandeep Vaidya MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.
**Sub-Events**

**RC421A**  
**Fluoroscopy Perspective**

Ehsan Samei PhD (Presenter): Research Grant, Siemens AG Research Grant, General Electric Company Research Grant, Carestream Health, Inc

**LEARNING OBJECTIVES**

1) To become familiar with major trends in fluoroscopy technology. 2) To understand transitions in technology that requires new and advanced evaluations. 3) To appreciate how a medical physicist is to effectively engage with clinical practice.

**ABSTRACT**

Just like other medical imaging modalities, fluoroscopy has been undergoing a number of technological transitions. Those include transitions from II to flat panel detectors and from 2D to 3D imaging. While these advances offer improvements and new possibilities, they challenge the conventional way a system is to be tested. In addition, given the interventional nature of the modality, there is an increasing need for the medical physicist to be more operationally engaged with the use and optimization of the technology. This lecture aims to offer a historical perspective on these topics and an outline of major priorities for fluoroscopic physics service.

**RC421B**  
**Fluoroscopy 1.0**

Beth A. Schueler PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review basic fluoroscopy imaging system performance evaluation tests. 2) Compare measurement procedures for fluoroscopic exposure assessment. 3) Become familiar with test procedures designed to assess fluoroscopic image quality. 4) Learn about implementation of patient dose management processes for fluoroscopic procedures.

**ABSTRACT**

This segment will provide a review of customary medical physics support activities for fluoroscopic imaging systems. Quality control testing procedures for image quality evaluation, radiation dose measurement and other mechanical performance characteristics are essential for optimizing equipment performance and ensuring patient and staff safety. Test equipment, phantoms, measurement methods and recommended performance criteria for these tests will be summarized as they apply to different types of fluoroscopic equipment, from angiographic imaging systems to radiographic-fluoroscopic (RF) tables and mobile C-arms. In addition, the medical physicist's role in clinical implementation of fluoroscopic systems will be discussed, including ensuring appropriate configuration of anatomical program settings, recommendations for patient dose management and methods for patient dose estimation.

**Active Handout**


**RC421C**  
**Fluoroscopy 2.0**

Keith J. Strauss MS (Presenter): Research Consultant, Koninklijke Philips NV Speakers Bureau, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) Understand need for and advantages of quantitative (as opposed to qualitative) analysis of image quality. 2) Identify and understand new tools becoming available for evaluating fluoroscopic equipment performance. 3) Identify appropriate configuration of acquisition parameters as a function of patient size. 4) Be able to configure the radiation dose to the detector to ensure diagnostic image quality at properly managed patient dose.

**ABSTRACT**

Abstract Steps that are required to turn physics support of fluoroscopy from a compliance focused to operationally focused program will be discussed. New metrics and analytics to better quantify high contrast resolution, low contrast resolution, temporal resolution, and 3D imaging will be examined. Changes in testing protocols necessary to address new hardware technologies, new acquisition methods, state-of-the-art image processing and analysis will be reviewed. A recently developed “physics testing mode” that the vendors will provide in the near future will be described. Proper management of patient dose metrics will be reviewed. The presentation concludes with clinical implementation of these new strategies. Proper training and communication
is critical. Proper configuration of acquisition parameters (focal spot size, voltage and added filter, tube current, pulse width, pulse rate, scatter removal) as a function of patient size from the smallest neonate to the largest bariatric patient is key to providing diagnostic image quality at properly managed radiation doses. In addition, one must ensure that the detector dose as a function of filter type and thickness, pulse rate, field of view, and complexity of the examination is properly configured.

**RC422**

**Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques—Margins and Margin Design**

*Refresh/Informatics*

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

**Participants**

**Moderator**  
Timothy Craig PhD: License agreement, Modus Medical Devices Inc Research Grant, RaySearch Laboratories AB

**LEARNING OBJECTIVES**

1) Incorporating IGRT uncertainties into treatment margins. 2) Approaches to using margins to mitigate uncertainties.

**Sub-Events**

**RC422A**  
**Incorporating IGRT Uncertainties into Treatment Margins**

Timothy Craig PhD (Presenter): License agreement, Modus Medical Devices Inc Research Grant, RaySearch Laboratories AB

**LEARNING OBJECTIVES**

1) Be able to identify the different terminology used to describe margins in radiation therapy. 2) Understand how different types of uncertainty contribute to the appropriate treatment margin. 3) Demonstrate an understanding of the many factors that can influence the margins required to account for treatment uncertainties. 4) Have the rationale to determine which approaches could/should be applied in their own practice.

**ABSTRACT**

During treatment planning a safety margin is added to the clinical target volume to ensure that the planned dose is actually delivered to the target. This margin may be calculated by correctly combining the contributions to the overall treatment uncertainty from numerous individual uncertainties. Once the uncertainties have been categorized, there are many ways in which they can be combined to give the actual treatment margin, and this must be done in a considered way. In this presentation we will describe how different uncertainties should be combined. We will describe published margin recipes, including the impact of different assumptions made in each recipe. These concepts will be discussed in the context of guidance documents from the International Commission on Radiation Units and Measurements.

**RC422B**  
**Approaches to Using Margins to Mitigate Uncertainties**

Julianne Marie Pollard PhD (Presenter): Speaker, Sun Nuclear Corporation Travel support, Sun Nuclear Corporation

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**ABSTRACT**

One advantage of IGRT is the potential for reducing margins. Clinical margins are typically determined in one of 3 ways: (1) Use same margins as before (pre-IGRT), (2) Reduce margins based on 'supposed' improvement in accuracy/precision, perhaps based on published data, or (3) Evaluate institutions own uncertainties, and establish appropriate margins. The first two are probably the most common. However, each of these approaches has its own pitfalls: (1) does not take full advantage of our new technologies, (2) is fraught with potential error, including the fact that many published works do not adequately assess uncertainties, and (3) can be difficult, and not all physicists have the background knowledge to do this. In this presentation we will describe some practical approaches to using margin formulae and other methods used to determine safe clinical margins. The limitations, risks and pitfalls will be described.
LEARNING OBJECTIVES

1) The audience will be able to identify and discuss the standard parameters used for reporting dose in computed tomography, including the volume CTDI, DLP, and effective dose using the k-coefficients. 2) The audience will be able to identify and discuss parameters which influence the radiation dose to the patient, including patient size, dose modulation protocols, and scan length. 3) Participants will be able to identify the limitations of using effective dose in describing radiation dose levels to individual patients.

ABSTRACT

Computed tomography has experienced rapid growth in utilization over the past 10 years, due in part to the dramatic increase in image quality and decrease in scan time that helical and multi-slice CT scanners have allowed. This increased utilization has raised legitimate concerns about the radiation dose levels in CT. Traditional dose metrics such as the volume computed tomography index (CTDIvol) and the dose length product (DLP) will be discussed. The limitations of these metrics in the context of individual patient dosimetry will also be explained. In recent years, a number of new CT dose concepts have been introduced in the peer-reviewed literature, in task group reports, and in other documents. A number of these new dose metrics will be discussed, including the rise-to-equilibrium-dose, H(L), and the site-specific dose estimate (SSDE). CT dosimetry has historically been performed using integrated ion chambers. In light of the dynamic scanning capabilities of modern CT scanners, the utility of a real-time radiation meter will be discussed. Real-time dose meters can substantially reduce the time required by the physicist in the CT scanner suite, while increasing the quantity and quality of the dose information that is measured. Niche applications include the rapid assessment of beam quality (half value layer) and the characterization of the beam shaping filters used in CT. In summary, this presentation will discuss existing CT dose parameters, and will then review a number of proposed new CT dose parameters which will likely be useful for CT dose assessment in the future. The recent growth of CT technology has outgrown the simple dose metrics of the past, and there is a need for the CT community to embrace new and more accurate CT dose metrics.

LEARNING OBJECTIVES

1) Recognize the limitations of current approaches to estimate CT patient dose. 2) Understand several methods available for estimating CT patient dose. 3) Understand potential future options for patient CT dose estimations.

ABSTRACT

Radiation over-exposure for computed tomography (CT) perfusion studies occurring in the 2008-2009 timeframe resulted in California Senate Bill 1237, legislation that was authored by Senator Padilla in response to these incidents. The legislation was signed by the Governor in September 2010. The law contains three parts: (1) Recording CT dose indices for each patient, placing these values in the radiology report, and verifying accuracy of the volume Computed Tomography Dose Index (CTDIvol); (2) Requiring accreditation for all CT scanners performing diagnostic exams that are under the authority of the California Department of Public Health; (3) Reporting of radiation exposures that exceed specified limits to organs, cause unanticipated erythema or hair loss, or inappropriate irradiation to body parts not ordered by a physician. Part 1 of the law commenced on July 1, 2012, and the other two parts are to commence on July 1, 2013. This presentation describes the steps taken to comply specifically with Part 1 of the law. To ensure compliance, an automated extraction and delivery of the CTDI vol and DLP indices to the radiology report were implemented. However, the legislation does not provide guidance on how to: (1) adjust CTDIvol for patient size; (2) deal with CT exams having multiple different series, each with individual dose indices; (3) sum CTDI vol and DLP for the same or different body areas scanned (if appropriate). The consequence is variable reporting at the initial implementation of the law, which requires standardized reporting metrics. Recommendations by the University
of California Dose Optimization and Standardization Endeavor (UC DOSE) is discussed in this context, with relevant solutions described and specific examples demonstrated. To conclude, an update from the users perspective of compliance, as well as reporting of the status from the State of California Department of Public Health office is provided.

**RC424**

**Mentored Case Approach to Pediatric Cardiovascular Disease 1: Vascular (An Interactive Session)**

*Refresher/Informatics*

VA PD

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

*Tue, Dec 2 4:30 PM - 6:00 PM  Location: E353B*

**Participants**

- S. Bruce Greenberg MD (Presenter): Nothing to Disclose
- Cynthia Karfias Rigsby MD (Presenter): Nothing to Disclose
- Taylor Chung MD (Presenter): Speaker, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) Understand the morphology, treatment, and long term complications of treated and untreated congenital heart disease via an interactive mentored-case approach with audience response system. 2) Highlight appropriateness of MRI and CT with regard to technique, pitfalls, indications and critical imaging findings that affect management for common imaging scenarios, including vascular rings and slings, coarctation, aortopathy, coronary anomalies, and congenital pulmonary arterial and venous anomalies. 3) Provide an opportunity for general radiologists, pediatric radiologists and cardiac imagers who have limited exposure to this area in their workplace an opportunity to refresh their pediatric cardiovascular imaging skills in a focused manner.

**Sub-Events**

**RC425**

**Quantitative Imaging: Informatics**

*Refresher/Informatics*

BQ IN PH

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

*Tue, Dec 2 4:30 PM - 6:00 PM  Location: E353A*

**The Role of Informatics in Quantitative Imaging**

Katherine P. Andriole PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the role of informatics in quantitative imaging. 2) Be able to identify existing limitations in information technologies with respect to quantitative imaging, and conversely see how informatics may assist in filling some of the current gaps in quantitative imaging methods. 3) Become familiar with on-going efforts to address current challenges facing research into and clinical implementation of quantitative imaging applications.

**ABSTRACT**

Quantitative imaging is increasingly becoming an essential part of biomedical research as well as being incorporated into clinical diagnostic activities. Referring clinicians are asking for more objective information to be gleaned from the imaging tests that they order so that they may make the best clinical management decisions for their patients. Medical Physicists, Researchers, Imaging Scientists, and others may be called upon to identify existing issues as well as develop, validate and implement new approaches and technologies to help move the field further toward quantitative imaging methods. Biomedical imaging informatics tools and techniques such as standards, integration, data mining, cloud computing and new systems architectures, ontologies and lexicons, data visualization and navigation tools, and business analytics applications can be used to overcome some of the existing limitations. The RSNA’s Quantitative Imaging Biomarkers Alliance (QIBA) is an initiative with international participation from medical physicists, clinicians, researchers, industry scientists, and government officials all interested in optimizing the potential of quantitative imaging. A major QIBA informatics activity, the imaging data warehouse is in progress. Current status and future plans will be described.

**Standards for Quantitative Imaging**

David A. Clunie MBBS (Presenter): Owner, PixelMed Publishing 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.

**RC425C**

**Clinical and Research Needs for Quantitative Imaging Informatics Tools**

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

**LEARNING OBJECTIVES**

1) Become familiar with the quantitative imaging tools that are available for clinical and research uses. 2) Become familiar with the clinical and research problems that are being addressed by quantitative imaging. 3) Become familiar with the clinical and research problems that might be addressed by quantitative imaging in the near future and how to prepare one's practice for these uses.

**ABSTRACT**

Quantitative imaging is more than just the measurement of structures in images. It is a new way of approaching diagnosis and therapy assessment. While simple linear measurements might qualify as quantitative imaging, it is important to think of QI in a much broader context. In addition to measuring spatial quantities like length, area, and volume, one can measure image values on functional imaging, which might represent a physiologic value. One can measure textures and edge properties, potentially replacing the 'it just looks like it' answer to why an expert can diagnose a certain disease. Measuring change can also be more than just spatial. Spatial change detection is important, of course, and doing it well is a critical component of QI. Measuring change in non-spatial properties is likely to become more important in the future. Finally, while some might believe that genomics will largely replace imaging, there is currently much interest in the use of imaging to provide pervasive and non-destructive prediction of genomic, proteomic, and metabolomic properties that are likely to be of great value to patient care.
LEARNING OBJECTIVES

1) Describe the clinical indications for prostate MRI and MRI-targeted interventions. 2) Assess technical considerations for performance of multi-parametric prostate MRI, including pulse sequences, coils, contrast administration, magnetic field strength. 3) Integrate information from T2, DCE, and DWI to analyze and report prostate MRI exams using new ACR-PIRADS methodology. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Sub-Events

RC429A  
Introduction to PI-RADS
Jeffrey C. Weinreb MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RC429B  
Technical Considerations
Clare M. C. Tempany-Afdhal MD (Presenter): Research Grant, InSightec Ltd Research Consultant, Profound Medical Inc

LEARNING OBJECTIVES
View learning objectives under main course title.

RC429C  
How to Use PI-RADS
Jelle O. Barentsz MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RC432  
Measuring Quality in Radiology
Refresher/Informatics

LEARNING OBJECTIVES

1) The technical steps required to develop and implement dashboards and scorecards (including data/state aggregation, semantic normalization, modeling, data mining, and presentation) will be discussed. 2) Specific strategies and technologies that can be used to create dashboards and scorecards (including HL7, DICOM, ETL, web services, and SOA) will be illustrated. 3) Strategies to create a sustainable and agile architecture to support advanced business intelligence and analytics (BIA) tools will be explored. (This course is part of the Leadership Track)

ABSTRACT

Current and near future requirements and constraints will require radiology practices to continuously improve and demonstrate the value they add to the enterprise. Merely “managing the practice” will not be sufficient; groups will be required to compete in an environment where the goal will be measurable improvements in efficiency, productivity, quality, and safety. Although the phrase “one cannot improve a process unless one can measure it” is a familiar platitude, it is an increasingly important and relevant concept. The proper leveraging of formal Business Intelligence and Analytics (BIA) is a critical, absolutely essential strategy for any radiology group. Although currently underutilized, concepts such as Key Performance Indicators (KPIs), tactical...
dashboards, and strategic scorecards, should be familiar tools for radiology groups attempting to "navigate disruption."

**Population Health: A Mandate for Leadership and Quality**

**Paul E. Berger MD (Presenter):** Chairman, Partners in the Imaging Enterprise, LLC Shareholder, Partners in the Imaging Enterprise, LLC

**LEARNING OBJECTIVES**

1) Define population health and articulate the essential role of quality in this new health care paradigm. 2) Consider the key role of patient experience in the concept of radiology quality. 3) Explore the concepts of quality and value in radiology. (This course is part of the Leadership Track)

**ABSTRACT**

Quality has become an essential component of radiology practices. But what is quality and how is it measured? The course will attempt to answer these questions from three perspectives. First, the perspective of quantitative radiology quality metrics and ways of measuring them will be explored, and methods of data analytics will be considered. Second, the concept of quality as it applies to a new health care delivery paradigm of population health will be analyzed. Population health is a framework in which health care entities and providers are tasked with keeping an entire defined population healthy, rather than the current healthcare delivery system that focuses largely on individual sick patients. The third speaker will address the essential role of patient satisfaction and positive patient experience in the concept of quality in radiology. These areas are increasingly prevalent in online rating sites, a domain that is not typically assessed with current standardized quality metrics.

**Quality: Going Beyond the Metrics**

**Jonathan W. Berlin MD (Presenter):** Stockholder, Nuance Communications, Inc Radiology Advisory Board, Nuance Communications, Inc

**LEARNING OBJECTIVES**

1) Define population health and articulate the essential role of quality in this new health care paradigm. 2) Consider the key role of patient experience in the concept of radiology quality. 3) Explore the concepts of quality and value in radiology. (This course is part of the Leadership Track)

**ABSTRACT**

Quality has become an essential component of radiology practices. But what is quality and how is it measured? The course will attempt to answer these questions from three perspectives. First, the perspective of quantitative radiology quality metrics and ways of measuring them will be explored, and methods of data analytics will be considered. Second, the concept of quality as it applies to a new health care delivery paradigm of population health will be analyzed. Population health is a framework in which health care entities and providers are tasked with keeping an entire defined population healthy, rather than the current healthcare delivery system that focuses largely on individual sick patients. The third speaker will address the essential role of patient satisfaction and positive patient experience in the concept of quality in radiology. These areas are increasingly prevalent in online rating sites, a domain that is not typically assessed with current standardized quality metrics.

**Vertebral Augmentation (How-to Workshop)**

**Refresher/Informatics**

**MK IR MK IR MK IR**

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

**Tue, Dec 2 4:30 PM - 6:00 PM Location: E260**

**Participants**

A. Orlando Ortiz MD, MBA (Presenter): Nothing to Disclose
Bassem Adeeb Georgy MD, MSc (Presenter): Consultant, Johnson & Johnson Consultant, DFINE, Inc Medical Advisory Board, SpineAlign Medical, Inc Stockholder, DFINE, Inc Stockholder, SpineAlign Medical, Inc Stockholder, Spine Solutions, Inc
Allan L. Brook MD (Presenter): Advisor, Johnson & Johnson Advisor, Medtronic, Inc
Afshin Gangi MD, PhD (Presenter): Proctor, Gallil Medical Ltd
Todd Stuart Miller MD (Presenter): Nothing to Disclose
Sudhir Kathuria (Presenter): Research Grant, Toshiba Corporation Research Grant, Siemens AG

**LEARNING OBJECTIVES**

1) Discuss appropriate algorithms for patient selection. 2) Review anatomic and technical considerations for vertebral augmentation. 3) Present an update of the recent advances in vertebral augmentation including sacroplasty. 4) Emphasize safety issues and how to avoid complications. 5) Understand the applications of vertebral augmentation in osteoporotic and
neoplastic spine pathology. 6) Update participants with respect to advances in equipment and biomaterials.

ABSTRACT

1. Patient selection for vertebral augmentation Indications and Contraindications 2. New devices and techniques in vertebral augmentation 3. Vertebral augmentation for osteoporotic and pathologic vertebral compression fractures 4. Sacroplasty (sacral augmentation) 5. Complications avoidance 6. Efficacy Vertebral augmentation is an image-guided (fluoroscopy or CT) percutaneous procedure in which a bone needle is inserted into a painful osteoporotic or pathologic fracture within the spinal axis. Biopsy, cavity creation or lesion ablation may then be performed under imaging guidance depending on the nature of the pathology that is being treated. Subsequently a radioopaque implant, usually an acrylic bone cement, is carefully injected into the vertebra or sacral ala under imagining guidance. These procedures have been shown to provide pain relief by stabilizing the fractured vertebral or sacrum. As with any other invasive procedure, they carry a small risk (<1%) of complication including bleeding, infection, neurovascular injury, or cement embolus. Appropriate patient selection and a detailed understanding of the technical aspects of the procedure along with active clinical patient follow-up are paramount to a successful outcome. This workshop will utilize short lectures, case examples and interactive audience participation in order to further explore critical topics in vertebral augmentation.

URL's

www.winthropradioogy.com

Imaging in Practice: MRI of the GIT (How-to Workshop)

Refresher/Informatics

MR GI
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 4:30 PM - 6:00 PM   Location: S404CD

SUB-EVENTS

MR Enterography Technique and Application in Inflammatory Bowel Disease

Flavius F. Guglielmo MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review the clinical indications for MR Enterography (MRE). 2) To learn an optimized MRE protocol. 3) To understand the clinical utility, advantages, and disadvantages of each MRE pulse sequence. 4) To discuss an imaging-based classification system for small bowel Crohn's disease. 5) To review the imaging findings for the different Crohn's disease subtypes.

Perianal Fistulizing Disease

Joel Garland Fletcher MD (Presenter): Grant, Siemens AG

LEARNING OBJECTIVES

1) To review the anatomy of the anal sphincter complex and pelvic floor. 2) To discuss standard MR perianal imaging for fistulas, and adaptations for ileoanal pouch, rectovaginal fistulas, and concurrent MR enterography. 3) To review the justification and rationale for MR anal imaging in patients with perianal Crohn's disease. 4) To describe time-efficient detection and classification of perianal fistulas. 5) To show how the appearance of perianal fistulas changes with treatment.

How to Use MRI for Rectal Cancer Staging

Gina Brown MD, MBBS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To appreciate optimal MRI techniques for accurate staging of Rectal Cancer. 2) To understand the implications for patient care from optimised staging. 3) To follow minimum reporting standards for reporting Rectal Cancers at baseline and after preoperative therapy.

Nerve Ultrasound Based on a Regional Approach: Shoulder and Neck (Hands-on Workshop)

Refresher/Informatics

US NR MK US NR NR
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 4:30 PM - 6:00 PM   Location: E264

Participants
Learning Objectives

1) Describe the ultrasound anatomy and scanning technique for examination of neck (i.e. brachial plexus, spinal accessory, long thoracic, phrenic, vagus) and shoulder (i.e. suprascapular, axillary, musculocutaneous) nerves. 2) Illustrate the main anatomic landmarks to identify these nerves. 3) Master technical approaches to nerve ultrasound including the recognition of pitfalls.

Abstract

In recent years, ultrasound of the musculoskeletal and peripheral nervous systems is becoming an increasingly imaging tool with an expanding evidence base to support its use. However, the operator dependent nature and level of technical expertise required to perform an adequate ultrasound assessment means that appropriate training is required. For this purpose, the present course will demonstrate the basic principles of musculoskeletal ultrasound with a special focus on the examination of small (<1mm thick) and difficult-to-study nerves. The standardized techniques of performing an adequate ultrasound study of the axillary nerve in the shoulder, the musculocutaneous nerve in the arm and the anterior interosseous nerve in the proximal forearm will be illustrated. Similarly, the examination technique to image the lateral femoral cutaneous nerve in the inguinal area and the saphenous nerve throughout the lower extremity will be described. The hands-on workshops will provide the opportunity to interactively discuss the role of ultrasound in this field with expert instructors. Participants will be encouraged to directly scan model patients. A careful ultrasound approach with thorough understanding of soft-tissue planes and extensive familiarity with anatomy are prerequisites for obtaining reliable information regarding the affected structure and the site and nature of the disease process affecting it.

RC453

Clinical Decision Support: Lessons from the Medicare Imaging Demonstration

Refresher/Informatics

AMAPRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50

Tue, Dec 2 4:30 PM - 6:00 PM Location: S104A

Participants

Moderator
Ramin Khorasani MD: Consultant, Medicalis Corp
Ramin Khorasani MD (Presenter): Consultant, Medicalis Corp
Safwan Halabi MD (Presenter): Nothing to Disclose
Keith David Hentel MD, MS (Presenter): Nothing to Disclose
Jonathan D. Darer MD, MPH (Presenter): Nothing to Disclose
Katherine L. Kahn MD (Presenter): Nothing to Disclose

Learning Objectives

1) Define Clinical Decision Support (CDS) and attributes of effective CDS for imaging to improve appropriate use of imaging. 2) Review implications of recent federal initiatives related to imaging CDS, including the Medicare Imaging Demonstration (MID), Meaningful Use, and Promoting Evidence-based care as part of the recently passed Protecting Access to Medicare Act of 2014 (HR4302). 3) Present the results of Medicare Imaging Demonstration concluded in 2014, to assess impact of targeted professional society guidelines (including the American College of Radiology’s Appropriateness Criteria) embedded as CDS on ambulatory high cost imaging procedures for fee for service medicare population. 4) Share and discuss lessons learnt about CDS from some of the participants in the MID.

URL’s

www.radhelper.com

RC454

Ergonomics

Refresher/Informatics

AMAPRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50

Tue, Dec 2 4:30 PM - 6:00 PM Location: S504AB
LEARNING OBJECTIVES

1) The attendee will learn how the radiology reading room environment can physically affect the radiologist. 2) Learn about repetitive stress injuries and how they may affect radiologists and technologists. 3) Learn about how PACS workstations (including mice, keyboards, screens, etc.); room lighting, sounds and temperature; and room furniture may be optimized to help prevent repetitive stress injuries. 4) Learn how radiologic technologists can also be affected by repetitive stress injuries.

ABSTRACT

This presentation will review the features of a reading a study at a PACS, and the interactions of the radiologist with the various devices. This includes desktops/tables height, chairs, keyboard location, monitor position, mouse position (and cleanliness), microphone positioning, room temperature, sound volume, ambient light, and body positioning. Each of these components will be discussed, showing how to prevent future problems with repetitive stress disorders. The goal is to raise awareness of ergonomics for the radiologist.

RCB35

Hands-on Natural Language Processing: Extracting Value from Imaging Reports (Hands-on)

Refresher/Informatics

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 4:30 PM - 6:00 PM  Location: S401CD

Participants

Scott Leroy Duvall PhD (Presenter): Research Grant, Amgen Inc Research Grant, Anolinx LLC Research Grant, AstraZeneca PLC Research Grant, F. Hoffmann-La Roche Ltd Research Grant, Merck & Co, Inc Research Grant, Mylan Inc Research Grant, PAREXEL International Corporation Research Grant, Shire plc
Daniel L. Rubin MD, MS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the workflow of natural language processing, including manual annotation, training, and evaluation. 2) Explain the role that natural language processing can play in imaging practice and research. 3) Describe different approaches for processing imaging report text. 4) Identify the functions of RadLex and other ontologies in natural language processing. 5) Explore ways that natural language processing could be used to address their current organizational needs. 6) Practice creating manual annotations on imaging reports and discussion challenges and solutions for reliable, efficient annotating. 7) Learn some available open-source tools that can be used for natural language processing and annotation.

ABSTRACT

Natural language processing (NLP) is key to unlocking the vast amount of information in imaging reports that is either typed directly by the clinicians or transcribed from speech recognition. Recent advances in available tools and a shift in mindset towards the development of NLP systems as pipelines of distinct, interchangeable modules have made many common NLP tasks within the reach of all researchers and clinicians. This workshop will provide attendees with a hands-on introduction to NLP and to some current research in which it is used on imaging reports. Participants will be guided through an overview of NLP, some of the current challenges of working with imaging text, and the strengths and weaknesses of different NLP approaches. Manual annotation - used to support NLP - will be introduced and participants will be guided through tools to create annotations. The role of RadLex and other ontologies will be discussed and tools for mapping to these standards will be demonstrated. Participants of the workshop will gain an understanding of how NLP could be used in their organizations to address specific clinical questions and experience with tools to perform simple NLP tasks.

Active Handout


RCC35

Technologies for Creating Educational Content and Teaching Files

Refresher/Informatics

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 4:30 PM - 6:00 PM  Location: S501ABC

Sub-Events

RCC35A  Podcasting and Screencasting for Teaching

Mahesh M. Thapa MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Identify the utility of podcasts and screencasts. 2) List major software packages available for creating podcasts and screencasts. 3) Understand the steps required to create a podcast or screencast.

**RCC35B**  
**e-Publishing**  
Michael L. Richardson MD (Presenter): Nothing to Disclose  
**LEARNING OBJECTIVES**  
1) Know the pros and cons of publishing electronic books. 2) Know the two main formats for publishing electronic books. 3) Be aware of several strategies for converting one’s book to electronic form. 4) Know the pros and cons of several software packages used for electronic book conversion.

**RCC35C**  
**Lecturing 2.0: Innovative Tools and Techniques to Improve the Way We Teach and Learn**  
Harprit Singh Bedi MD (Presenter): Nothing to Disclose  
**LEARNING OBJECTIVES**  
1) Identify techniques to incorporate mobile technology into your teaching program. 2) Appraise your current teaching practices in light of the new pedagogical approaches introduced in the lecture.

**MSRO39**  
**BOOST: Gynecology—Hands-on Contouring**  
*Multisession Courses*  

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AMA PRA Category 1 Credits™: 1.25  
ARRT Category A+ Credits: 1.50  
Tue, Dec 2 4:45 PM - 6:00 PM  Location: S101A  

**Participants**  
Beth A. Erickson MD (Presenter): Nothing to Disclose  
**LEARNING OBJECTIVES**  
1) Contour Post-operative pelvis :Nodal CTV and Vaginal ITV. 2) Contour an intact cervical case. 3) Contour the GTV and HR CTV at the time of cervical brachytherapy.  
**ABSTRACT**  
Proper contouring of radiation targets and organs at risk is essential in developing treatment plans which maximize the benefits and minimize the risks of radiation, both for external beam and brachytherapy. This course will focus on contouring the nodal CTV and vaginal ITV for a post-op endometrial cancer patient as well as the non-nodal CTV and nodal CTV for an intact cervix patient as well as the GTV and HR CTV for a patient at the time of cervical brachytherapy.