

**Thursday**

SPSC50

## Controversy Session: Interventional Radiology of the Future: Hoarders or Stewards?

Thursday, Dec. 3 7:15AM - 8:15AM Location: E351



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

### Participants

Jeanne M. Laberge, MD, San Francisco, CA (*Moderator*) Consultant, W. L. Gore & Associates, Inc;

### LEARNING OBJECTIVES

1) Describe the upcoming changes in IR training mandated by the Accreditation Council for Graduate Medical Education (ACGME). 2) List procedural areas of image-guided intervention that are sometimes performed outside of the IR section proper by radiologists who are not subspecialty trained in Vascular and Interventional Radiology (VIR). 3) Explain what the term "peri-procedural clinical care" means as applied to image-guided interventions. 4) Assess the value of the new IR residency in advancing clinical care. 5) Specify the advantages of retaining image-guided procedural expertise within areas of the Radiology department outside of IR.

### ABSTRACT

In September 2014, the Accreditation Council for Graduate Medical Education (ACGME) approved the program requirements for a new training program in Interventional Radiology (IR). The new IR residency will provide training in imaging, image-guided interventions and clinical care. Preparing residents to care for patients before, during and after image-guided procedures, is a major focus of the new program. Physicians may enter training directly from medical school (after completing a clinical internship) or they may enter after completing a residency in Diagnostic Radiology. This new development in IR training may have implications for the practice of image-guided interventions outside of IR. In this course, the moderator will describe the components of the new IR training program. The speakers will explain how this new training paradigm may change the practice of image-guided interventions within the specialty of Interventional Radiology and also outside the field of IR. The potential implications of this change in IR training for the radiology department as a whole will be explored.

### Sub-Events

#### SPSC50A This is IR Authority

#### Participants

John A. Kaufman, MD, Portland, OR (*Presenter*) Consultant, Bio2 Technologies, Inc; Consultant, Cook Group Incorporated; Consultant, Medtronic, Inc; Consultant, W. L. Gore & Associates, Inc; Consultant, Guerbet SA; Stockholder, Hatch Medical LLC; Stockholder, VuMedi, Inc; Stockholder, Veniti, Inc; Royalties, Reed Elsevier; Advisory Board, Delcath Systems, Inc; Researcher, W. L. Gore & Associates, Inc; Researcher, Guerbet SA; Researcher, BTG International Ltd; Researcher, EKOS Corporation; Stockholder, EndoShape, Inc; Advisory Board, AV Medical; Advisory Board, Javelin Medical

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### SPSC50B 'Not That Straightforward'

#### Participants

Susan D. John, MD, Houston, TX (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

SPSH50

## Hot Topic Session: Dual-energy CT for GU Imaging

Thursday, Dec. 3 7:15AM - 8:15AM Location: E350



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

### Participants

Hersh Chandarana, MD, New York, NY (*Moderator*) Equipment support, Siemens AG; Software support, Siemens AG; Consultant, Bayer, AG;

### LEARNING OBJECTIVES

1) This course will cover the basics and application of Dual Energy CT in GU Radiology.

### ABSTRACT

#### Sub-Events

#### SPSH50A Principles of DECT

### Participants

Daniel T. Boll, MD, Durham, NC (*Presenter*) Research Grant, Siemens AG; Research Grant, Koninklijke Philips NV; Research Grant, Bracco Group

#### SPSH50B DECT of GU Masses-2015 Update

### Participants

Terri J. Vrtiska, MD, Rochester, MN (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Discuss DECT advantages for renal mass evaluation. 2) Describe useful DECT applications for renal mass characterization. 3) Summarize recent literature and future opportunities of DECT of renal masses.

### ABSTRACT

Application of DECT to renal mass evaluation and improved characterization.

### URL

#### SPSH50C Establishing DECT in Your Practice: Nuts and Bolts

### Participants

Avinash R. Kambadakone, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe the basic principles, technique and clinical applications of DECT. 2) Identify and appraise the different technologies, workflow implications and challenges of DECT in day-to-day practice. 3) Apply and incorporate the most appropriate DECT protocols into routine practice.

### ABSTRACT

### URL

MSRT51

## ASRT@RSNA 2015: Healthcare in the Developing World... Education is the Key

Thursday, Dec. 3 8:00AM - 9:00AM Location: N230

ED

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

### Participants

Joseph E. Whitton, MS, RT, Stony Brook, NY (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Define a variety of challenges to the delivery of healthcare services in remote areas of developing nations. 2) Identify the limited physical resources being currently utilized in rural hospitals in Kenya. 3) Assess the need for standardized procedures and education as a key component to the advancement of healthcare delivery in this region of the world.

### ABSTRACT

Description: This presentation will discuss the experience of delivering healthcare as a participant in a medical mission to the remote area of Meru, Kenya. Healthcare providers in this region struggle to meet the challenge of treating as many people as possible with very limited resources. Healthcare professionals from Stony Brook University worked with hospital staff to share methods and procedures to help them in this endeavor. We found that equally important as is the need for material goods is the necessity of education to use and maintain them properly. Outline: I Purpose of the SBU Medical Mission to Kenya Background Connections across the globe Members of the mission team Medical Imaging as new members II Life in Meru, Kenya Geography and history of the region Cultural Challenges Healthcare delivery challenges III Consolata Mission Hospital Physical facilities and hospital infrastructure Available technology Limited supplies and resources IV What Can We Do to Help? Equipment and supplies Education Standardized procedures Equipment maintenance



RC612

## Peripheral Artery Disease (PAD)

Thursday, Dec. 3 8:30AM - 10:00AM Location: N229

**VA** **CT** **MR**

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

**FDA** Discussions may include off-label uses.

### Participants

Stephen T. Kee, MD, Stanford, CA (*Moderator*) Nothing to Disclose

### LEARNING OBJECTIVES

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

### ABSTRACT

#### Sub-Events

#### RC612A Clinical Overview of PAD

#### Participants

Stephen T. Kee, MD, Stanford, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### RC612B Lower Extremity CTA

#### Participants

Richard L. Hallett II, MD, Stanford, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

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

### ABSTRACT

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

### URL

**Active Handout: Richard Lee Hallett**

[http://abstract.rsna.org/uploads/2015/13012018/Active\\_RC612B.pdf](http://abstract.rsna.org/uploads/2015/13012018/Active_RC612B.pdf)

#### RC612C Lower Extremity MRA

#### Participants

Harald Kramer, MD, Munich, Germany (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

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

### ABSTRACT

The prevalence of symptomatic peripheral artery disease (PAD) ranges around 3% in patients aged 40 and 6% at an age of 60 years. Additionally, the prevalence of asymptomatic PAD lies between 3% and 10% in the general population increasing to 15% to 20% in persons older than 70 years of age. However, these data still might underestimate the total prevalence of PAD since

screening studies showed that between 10% and 50% of all patients with intermittent claudication (IC) never consult a doctor about their symptoms. These data prove the need for an accurate and reliable method for assessment of the peripheral vasculature. Digital subtraction angiography (DSA) still serves as the reference standard for all vascular imaging techniques. However, because of the absence of ionizing radiation, the use of non-nephrotoxic contrast agents or even non contrast-enhanced sequences and the large toolbox of available techniques for high-resolution static and dynamic imaging Magnetic Resonance Angiography (MRA) constitute an excellent non-invasive alternative. Different acquisition schemes and contrast agent application protocols as well as different types of data sampling for static, dynamic, contrast- and non contrast-enhanced imaging enable to tailor each exam to a specific question and patient respectively.

#### **RC612D Endovascular Treatment of PAD**

Participants

Stephen T. Kee, MD, Stanford, CA (*Presenter*) Nothing to Disclose

#### **LEARNING OBJECTIVES**

View learning objectives under main course title.

## Interventional Series: Non-Vascular Interventions

Thursday, Dec. 3 8:30AM - 12:00PM Location: N226

**IR**

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

**FDA**

Discussions may include off-label uses.

### Participants

Steven M. Zangan, MD, Chicago, IL (*Moderator*) Nothing to Disclose  
Albert A. Nemcek JR, MD, Chicago, IL (*Moderator*) Consultant, B. Braun Melsungen AG

### LEARNING OBJECTIVES

1) Describe one technique to treat ascites. 2) Explain the rationale for genomic analysis. 3) Describe two techniques to treat refractory abscesses. 4) List pros and cons of staged non-vascular interventions. 5) Describe one MR guided intervention. 6) List two indications of percutaneous cholecystostomy.

### Sub-Events

#### RC614-01 Treating Ascites: Paracentesis, TIPs, PleuRx, Denver Shunt. Which One and Why?

Thursday, Dec. 3 8:30AM - 8:50AM Location: N226

### Participants

Albert A. Nemcek JR, MD, Chicago, IL (*Presenter*) Consultant, B. Braun Melsungen AG

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### RC614-02 Confocal Laser Endomicroscopy for Microscopic Characterization of Kidney and Liver Tumors during Ongoing in Vivo Percutaneous Biopsies and ex Vivo Cryoablation: Preliminary Results

Thursday, Dec. 3 8:50AM - 9:00AM Location: N226

### Participants

Afshin Gangi, MD, PhD, Strasbourg, France (*Presenter*) Nothing to Disclose  
Julien Garnon, MD, Strasbourg, France (*Abstract Co-Author*) Proctor, Galil Medical Ltd  
Georgia Tsoumakidou, MD, Strasbourg, France (*Abstract Co-Author*) Nothing to Disclose  
Jean Caudrelier, MD, Strasbourg, France (*Abstract Co-Author*) Nothing to Disclose  
Pramod P. Rao, MBBS, DMRD, Villejuif, France (*Abstract Co-Author*) Nothing to Disclose  
Herve Lang, Strasbourg, France (*Abstract Co-Author*) Nothing to Disclose  
Iulian Enescu, Strasbourg, France (*Abstract Co-Author*) Nothing to Disclose  
Guillaume Koch, MD, MSc, Strasbourg, France (*Abstract Co-Author*) Nothing to Disclose  
Veronique Lindner SR, MD, Strasbourg, France (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Needle-based Confocal Laser Endomicroscopy (nCLE) is an emerging imaging modality that enables visualization of histologic details during percutaneous coaxial needle procedures. This study is evaluating the nCLE technique during image-guided percutaneous biopsy or ablations for kidney and liver tumors.

### METHOD AND MATERIALS

The confocal imaging miniprobe (diameter 0.85mm, field of view 325µm, resolution 3.5µm, imaging depth 40 to 70µm) was used in conjunction with a coaxial needle (18-gauge) in 5 patients in vivo (3 liver and 2 kidney biopsies). The coaxial needle was first positioned in the lesion under CT guidance. The miniprobe was then inserted in the coaxial needle and placed in contact with the lesion. A volume of 2,5ml of 10% fluorescein was injected intravenously before endomicroscopic imaging using a 488nm laser source. Complementary endomicroscopic and CT scan information were used to accurately adjust the needle into the targeted lesion. Biopsies were subsequently performed as per standard of care. A pathologist performed side by side histological comparison and correlation in order to define interpretation criteria. Additionally, 2 pork kidneys were imaged with nCLE ex vivo during cryoablation, following a 12-hour staining in a bath of fluorescein. The miniprobe was inserted 15 mm apart from the cryoprobe.

### RESULTS

nCLE was successfully performed in all 5 patients with good quality images and movies. The pathologist was not yet able to give a precise histological diagnosis on nCLE in real-time but was able to recognize the difference in tissue architecture between fibrosis, necrosis, normal tissue and tumor areas (Fig.) with excellent correlation to traditional microscopy of the biopsy specimen. During cryoablation of ex vivo kidneys, nCLE was able to visualize clearly in real time the ice formation and tissue thawing at the location of the miniprobe. No adverse event has been observed in patients.

### CONCLUSION

nCLE demonstrated distinct tissue abnormalities during percutaneous biopsy. These preliminary results suggest that nCLE is feasible and safe during interventional radiology procedures for image-guided percutaneous biopsies. This technique could be a valuable tool to help the radiologist target the lesion and monitor therapy, thus increasing biopsy yield and ablation precision.

### CLINICAL RELEVANCE/APPLICATION

nCLE may serve as a new tool for increasing the precision of biopsies and ablations at the cellular level.



## Handout: Afshin Gangi

[http://abstract.rsna.org/uploads/2015/15009633/cofocal Microscopy.pptx](http://abstract.rsna.org/uploads/2015/15009633/cofocal%20Microscopy.pptx)

### RC614-03 **Ultrasound Guided Random Liver Biopsy: Impact of Biopsy Core Size on Specimen Adequacy and Procedural Complications**

Thursday, Dec. 3 9:00AM - 9:10AM Location: N226

#### Participants

Mitchell E. Tublin, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose  
Rosalind Blair, BA, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Joseph A. Martin, BA, BS, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Kristine Ruppert, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Anthony Demetris, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Despite recent imaging innovations, liver biopsy remains the gold standard for the evaluation of diffuse liver disease. A recent consensus document of the American Association for the Study of Liver Diseases (AASLD) has stressed the importance of obtaining sufficient size samples ( $\geq 16G$ ) in order to minimize sampling errors of irregularly distributed liver disease. Despite this, many centers continue to utilize smaller gauge core systems to minimize perceived increased procedural complication risks. The purpose of this study was to assess the impact of core gauge (18 vs. 16G) on specimen adequacy and procedural complications.

#### METHOD AND MATERIALS

149 patients referred for liver biopsy were sequentially randomized to 16 or 18G ultrasound (US) guided core biopsy under this HIPPA compliant IRB study. Patients were blinded to gauge size. Local anesthesia was administered for lateral segment biopsy. Post procedure hemorrhage was qualitatively evaluated (mild, moderate, severe) and pain was assessed using a 10 point rating scale at 1, 3 and 24 hours. Retrospective review of specimen adequacy included the # of cores obtained, length, and # of portal tracts. Based upon AASLD guidelines, specimen adequacy was defined as  $\geq 11$  portal tracts. Differences in pathology metrics and pain scoring were assessed using Chi square and linear regression models.

#### RESULTS

No significant hemorrhage requiring hospitalization occurred in either group and there was no difference in grouped pain scores. Mean 16G core specimen length was less than 18G length (1.7 cm vs. 1.9 cm/  $p < .05$ ). The mean # of portal tracts obtained with 16G biopsies was greater than 18G systems (14 vs. 13) though the difference was not significant ( $p=.1$ ). 81% of 16G biopsies and 71% of 18G biopsies were adequate based upon AASLD criteria, though the difference was also not significant ( $p=.17$ ).

#### CONCLUSION

The safety profile of US guided 18G and 16G core biopsy specimens is similar; a large % of 18 or 16G core specimens are inadequate when the AASLD specimen adequacy threshold is applied, and the adequacy rate is not significantly affected by biopsy gauge.

#### CLINICAL RELEVANCE/APPLICATION

Similar safety profiles, and the large % of inadequate specimens obtained with 18 and 16G core devices may prompt consideration of alternative approaches to the diagnosis of diffuse liver disease, which might include routine multiple sampling or obligatory supplemental non-invasive imaging (i.e. MRE, sonoelastography).

### RC614-04 **Percutaneous Biopsy for Genomic Analysis-What You Need to Know**

Thursday, Dec. 3 9:10AM - 9:30AM Location: N226

#### Participants

Steven M. Zangan, MD, Chicago, IL (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.

### RC614-05 **Refractory Pancreatic Abscesses-The Multidisciplinary Approach**

Thursday, Dec. 3 9:30AM - 9:50AM Location: N226

#### Participants

Rakesh C. Navuluri, MD, Chicago, IL (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.

### RC614-06 **Unknown Case of the Session**

Thursday, Dec. 3 9:50AM - 10:10AM Location: N226

#### Participants

Steven M. Zangan, MD, Chicago, IL (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.

### RC614-07 **Debate: Staged Procedures**

Thursday, Dec. 3 10:10AM - 10:30AM Location: N226

#### Participants

Steven M. Zangan, MD, Chicago, IL (*Presenter*) Nothing to Disclose  
Charles T. Burke, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.

#### RC614-08 Feasibility of Gallbladder Cryoablation: Proof of Concept in a Swine Model

Thursday, Dec. 3 10:30AM - 10:40AM Location: N226

#### Awards

##### Trainee Research Prize - Resident

#### Participants

Hugh C. McGregor, MD, San Francisco, CA (*Presenter*) Research Grant, HealthTronics, Inc  
Maythem Saeed, DVM, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Andrew Surman, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Steven W. Hetts, MD, San Francisco, CA (*Abstract Co-Author*) Consultant, Silk Road Medical Inc Consultant, Medina Medical Inc  
Research Grant, Stryker Corporation Data Safety Monitoring Board, Stryker Corporation  
Mark W. Wilson, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Miles B. Conrad, MD, Tucson, AZ (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Perioperative mortality during high-risk cholecystectomy may be as high as 19%, indicating a need for a minimally invasive definitive treatment option. This study investigates the feasibility of gallbladder cryoablation (GBC) in a swine model.

#### METHOD AND MATERIALS

Animals: Under IACUC approval, five farm pigs (30-45 kg) were used in this acute study. Contrast enhanced CT: A contrast enhanced CT of the abdomen was acquired for planning purposes. Cryoablation: The Endocare® Cryocare® cryoablation system was used. Under CT guidance, up to 4 cryoprobes were positioned percutaneously about the gallbladder. Two freeze-thaw cycles ranging from 10 to 26 minutes were performed with intermittent CT scanning to ensure adequate ablation margins. Thermocouple probes were placed percutaneously at the gallbladder fundus, neck, free wall, and gallbladder fossa. Histology: Five hours following completion of the last freeze cycle, the pigs were sacrificed. The gallbladder and ducts were resected en bloc and fixed in formalin with the thermocouple sites marked with sutures. Histology was assessed following hematoxylin and eosin staining.

#### RESULTS

Cryoablation: GBC was successful in all 5 pigs using 3 to 4 cryoprobes and freeze cycles ranging from 10 to 26 minutes. All thermocouple probes reached at least -20 C. Intra- and post- procedural heart rate, blood pressure, and oxygen saturation remained stable. Intra-procedural body temperature consistently decreased to below 95 F and recovered after the procedure. Imaging: The gallbladders measured less than 6 cm in greatest dimension. A 5 mm ablation margin was achieved about the gallbladder, including the adjacent hepatic parenchyma in the gallbladder fossa. Non-target ablation occurred in 1 animal (stomach), with less than 5 mm of ice ball penetration. Histology: Histologic specimens demonstrated denudation of the gallbladder epithelium, hemorrhage and edema within the muscularis layer, and an inflammatory infiltrate within the adventitia. Sparing of the common bile duct was also noted.

#### CONCLUSION

GBC in swine is feasible, with transmural ablation and sparing of adjacent structures achieved. Gastric inclusion in the ablation zone will require hydrodissection or continuous lavage in future experiments.

#### CLINICAL RELEVANCE/APPLICATION

GBC is feasible, offering a potential minimally invasive treatment option for high-risk patients. Long-term studies are needed to further explore the safety and efficacy of GBC.

#### RC614-09 Percutaneous versus Open Surgical Drainage of Abdominal Abscesses: Trends in Use of the Two Approaches

Thursday, Dec. 3 10:40AM - 10:50AM Location: N226

#### Participants

David C. Levin, MD, Philadelphia, PA (*Presenter*) Consultant, HealthHelp, LLC; Board of Directors, Outpatient Imaging Affiliates, LLC  
Laurence Parker, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Vijay M. Rao, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To compare trends in the use of percutaneous and surgical approaches to treating abdominal abscesses in recent years in a large population.

#### METHOD AND MATERIALS

The nationwide Medicare Physician/Supplier Procedure Summary Master Files for 2001 through 2013 were searched. This database covers over 37.3 million Medicare fee-for-service beneficiaries. It provides volume and other administrative data on every procedure code in the Current Procedural Terminology, version 4 (CPT-4) manual. CPT-4 codes were selected for the 4 types of abdominal abscesses that had distinct codes for both open surgical and percutaneous drainage - appendiceal, peritoneal, subphrenic, and liver. Medicare specialty codes were used to determine if the procedures were performed by radiologists or other nonradiologist physicians. Trends in use of the 2 approaches were compared.

## RESULTS

In 2001, there were 14,068 abdominal abscesses drained percutaneously. This volume increased progressively every year thereafter, reaching 28,486 in 2013 (+102%). Open surgical drainage volume was 8146 in 2001, decreasing progressively to 6397 in 2013 (-21%). In 2001, 63% of all abdominal abscesses had been drained percutaneously; by 2013 this figure had risen to 82%. In 2001, radiologists performed 97% of all percutaneous abdominal abscess drainages, and this percent share remained unchanged in 2013. Of all abdominal abscesses treated in 2013 in Medicare patients, 79% were treated by radiologists.

## CONCLUSION

Percutaneous drainage of abdominal abscesses has steadily gained in utilization, while that of open surgical drainage has declined. The vast majority of these abscesses are now treated percutaneously. Radiologists strongly predominate in performing the procedures. Although this database does not provide information on outcomes, percutaneous drainage is another good example of radiology-related value, in that an imaging-based interventional procedure developed by radiologists has largely replaced an older surgical approach that is more invasive, more costly, and carries greater morbidity for the patient.

## CLINICAL RELEVANCE/APPLICATION

The vast majority of abdominal abscesses are now treated by percutaneous drainage.

### RC614-10 Accuracy Testing of a Needle Placement Robot for Biopsy Under CT Guidance: Validation with Animal Study

Thursday, Dec. 3 10:50AM - 11:00AM Location: N226

#### Participants

Sang Young Oh, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Joon Beom Seo, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Namkug Kim, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Stockholder, Coreline Soft, Inc  
Hongho Kim, Yongin-si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hee Jun Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Purpose of this study is to evaluate accuracy of a needle placement robot for biopsy with swine including artificial lesions.

## METHOD AND MATERIALS

The robot system including 5-axis robot arm, a mobile platform with motor controllers, dedicated workstation for planning of needle path, and the navigation system (Polaris Spectra®; NDI, Canada) was developed. It provides useful functions including such as needle path planning, respiration monitoring, laser guidance, automatic needle positioning and guiding. To evaluate the accuracy and repeatability of the system in needle placement, two swine were used. For preparation, they were anesthetized and ventilated. Under CT guidance (Sensation 16, Siemens, Germany), multiple metallic markers were inserted to the liver, kidney and paraspinal muscle. The respiration of the swine was controlled with ventilator and intravenous injection of muscle relaxant. CT scan was performed to localize the target lesion and the CT data was transferred to the system. The spatial relation between swine and the robot system was registered with navigation system. After planning the needle path on workstation, the spatial information was translated to the robotic system. The robot system automatically angulates the needle to the target and depth of insertion is determined. Total of 22 needle insertion trials to 9 artificial target lesions at different needle paths was performed. Using the CT images after the insertion, distance between the target and actual needle tip and angle between preplanned route and actual needle pathway were measured. In 12 trials, repeated insertion of needle was performed to assess reproducibility.

## RESULTS

All experiment was done without complication. The procedure time between the initial CT scan and CT scan after needle insertion was  $7.8 \pm 2.7$  minutes. The distance and angulation were  $8.5 \pm 5.1$  mm and  $7.1 \pm 5.6$  degree, respectively. The distance and angle of repeated insertion with same planning was reproducible (ICC=0.931, 0.914, respectively).

## CONCLUSION

Developed robot system provides fast and reliable guidance of needle placement with CT imaging in animal experiment.

## CLINICAL RELEVANCE/APPLICATION

Developed robot system might be useful assisted tool in CT guided biopsy and ablation therapy, providing variable functions including such as needle path planning, respiration monitoring, laser guidance, automatic needle positioning and guiding.

### RC614-11 MR Guided Intervention

Thursday, Dec. 3 11:00AM - 11:20AM Location: N226

#### Participants

Aytekun Oto, MD, Chicago, IL, (oto@uchicago.edu) (*Presenter*) Research Grant, Koninklijke Philips NV; ; ;

## LEARNING OBJECTIVES

View learning objectives under main course title.

## Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Aytekun Oto, MD - 2013 Honored Educator

### RC614-12 Cholecystostomy. Update for 2015 (or Do Surgeons Ever Operate on Acute Cholecystitis Anymore?)

Thursday, Dec. 3 11:20AM - 11:40AM Location: N226

Participants

Charles T. Burke, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**RC614-13 Wrap Up and Discussion**

Thursday, Dec. 3 11:40AM - 12:00PM Location: N226

Participants

RC601

## Contemporary Imaging of Lung Cancer

Thursday, Dec. 3 8:30AM - 10:00AM Location: N227



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

### Participants

Jeremy J. Erasmus, MD, Houston, TX (*Moderator*) Nothing to Disclose

### Sub-Events

#### RC601A Non-small Cell Lung Cancer Staging: Concepts and Controversies

### Participants

Ioannis Vlahos, MRCP, FRCR, London, United Kingdom (*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.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Ioannis Vlahos, MRCP, FRCR - 2015 Honored Educator

#### RC601B Contemporary Concepts in Small Cell Lung Cancer

### Participants

Fergus V. Gleeson, MBBS, Oxford, United Kingdom (*Presenter*) Consultant, Alliance Medical Limited; Consultant, Blue Earth Diagnostics Limited; Consultant, Polarean, Inc;

### LEARNING OBJECTIVES

1) To learn the clinical manifestations, staging and prognostic factors of small cell lung cancer. 2) To become familiar with the role of PET-CT in the investigation and management of small cell lung cancer. 3) To review unusual presentations of small cell lung cancer and their investigation and treatment.

### ABSTRACT

Small cell lung cancer, SCLC, accounts for approximately 15% of all lung cancers, with its overall incidence decreasing, although it is increasing in women, with the male to female incidence ratio now 1:1. Small cell lung cancer has a more rapid doubling time than non-small cell lung cancer, with most patients presenting with hematogenous metastases, and only approximately one-third presenting with limited-stage disease confined to the chest. Small cell lung cancer uncommonly presents with a solitary pulmonary nodule, and the disease does not appear to have benefited from Lung Cancer Screening. There are multiple neurologic and endocrine paraneoplastic syndromes associated with small cell lung cancer, with marked improvement on treatment of the underlying tumour. Historically SCLC was staged according to the Veteran's Administration Lung Group's 2 stage classification of 1) extensive-stage disease or 2) limited-stage disease, and this classification used to guide therapy. More recently it has been recommended that SCLC is staged according to the International Association of the Study of Lung Cancer (IASLC) and the AJCC Cancer Staging Manual 7th edition, using the same staging system for NSCLC and SCLC. Whilst contrast enhanced CT scan of the chest and abdomen remain routine as the initial method for staging SCLC, FDG PET-CT now plays a more important role in staging and management. SCLC is a highly metabolic disease, and PET-CT both upstages and downstages disease, potentially altering management

#### RC601C PET Imaging of Lung Cancer: Beyond Standard Metabolic Assessment

### Participants

Eric M. Rohren, MD, PhD, Houston, TX (*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 application and clinical use of advanced metabolic imaging biomarkers derived from FDG-PET/CT using 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.

#### Honored Educators

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Eric M. Rohren, MD, PhD - 2015 Honored Educator

#### RC601D MRI: Advances in Nodule Characterization and Lung Cancer Staging

##### Participants

Kyung S. Lee, MD, PhD, Seoul, Korea, Republic Of, (kyungs.lee@samsung.com) (*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

#### RC601E CT Perfusion Imaging in Lung Cancer

##### Participants

Friedrich D. Knollmann, MD, PhD, Sacramento, CA, (fknollmann@ucdavis.edu) (*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.

#### RC601F Thoracic Oncologic Imaging: Treatment Effects and Complications

##### Participants

Brett W. Carter, MD, Houston, TX (*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.

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educational content in their field of study. Learn how you can become an honored educator by visiting the website at:  
<https://www.rsna.org/Honored-Educator-Award/>

Brett W. Carter, MD - 2015 Honored Educator

RC610

## Ultrasound Contrast (An Interactive Session)

Thursday, Dec. 3 8:30AM - 10:00AM Location: S402AB



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

**FDA** Discussions may include off-label uses.

### Participants

### Sub-Events

#### RC610A Renal Masses

### Participants

Edward G. Grant, MD, Los Angeles, CA (*Presenter*) Research Grant, General Electric Company ; Medical Advisory Board, Nuance Communications, Inc

### LEARNING OBJECTIVES

1) Understand the indications for the use of contrast enhanced ultrasound in renal masses. 2) Be familiar with the advantages and disadvantages of contrast enhanced ultrasound in comparison to other forms of cross sectional imaging with regard to its application to renal masses. 3) Be able to analyze contrast enhanced ultrasound images of the kidney. 4) Understand the basics of quantitative contrast imaging of renal masses.

### ABSTRACT

Contrast enhanced ultrasound (CEUS) has numerous applications in the imaging of renal masses. It has the particular advantage in this population of being able to be used in patients with renal failure which is not the case with either CT or MRI. Obviously CEUS does not use ionizing radiation and is less expensive than other techniques. A further advantage is the fact that ultrasound is a real time technique and vascular characteristics of lesions can be evaluated throughout the examination. Applications of CEUS in the kidney include imaging of complex cysts (flow in wall, septae etc.) and evaluation of pseudolesions (column of Bertin, infarct, scars). It can also be used to further characterize indeterminate masses on CT/MR and may be able to classify some lesions as benign versus malignant, or suggest their actual histology. The diagnostic capability of CEUS is facilitated by its ability to provide quantitative information. Given the lack of ionizing radiation and absence of nephrotoxicity CEUS is ideal for patients undergoing active surveillance of a renal mass or post resection/RFA. The evaluation of complex renal cysts is one of the most common indications for CEUS. Observed features at CEUS are typically similar to those of the Bosniak classification and this has now been adapted for use with ultrasound contrast. In solid renal masses CEUS may provide information that can help determine the nature of the mass and its anatomy as well as the number of individual lesions. This is particularly valuable in patients in whom other contrast agents are contraindicated. One notable example is the characteristic enhancement pattern of papillary versus clear cell renal cell carcinoma. The former typically enhances less than the surrounding parenchyma throughout the examination while the latter dramatically hyperenhances in the arterial phase. Again, quantitative imaging can further add to the confidence of the diagnosis in such cases.

#### RC610B Contrast Ultrasound of the Liver and Gallbladder

### Participants

Hans-Peter Weskott, MD, Hannover, Germany, (weskotthp@t-online.de) (*Presenter*) Luminary, General Electric Company; Speaker, Bracco Group

### LEARNING OBJECTIVES

1) Understanding the indications of contrast enhanced ultrasound (CEUS) in focal liver and gallbladder diseases. 2) Learning about the importance of the three contrast phases and how CEUS performs in detecting and characterizing focal liver lesions and to characterize inflammatory and tumorous changes of the gallbladder wall. 3) Learning about the potential value as well as the limitations of CEUS in liver and gallbladder diseases. 4) Learning how CEUS performs when compared to B-mode and Color Doppler ultrasound, CT and MRI imaging.

### ABSTRACT

**Liver:** In patients with favorable scanning conditions CEUS is at least as sensitive as contrast enhanced CT (CECT) in detecting malignant liver lesions. Due to its high temporal resolution, even a hyper-enhancement of a few seconds can reliably be detected, thus improving the characterization of focal liver lesions. A majority of malignant lesions can therefore be characterized as hypo-, iso- or hyper-enhancing. During the arterial phase the tumor's vessel architecture and direction of contrast filling is important for characterizing a lesion's character. Due to a high spatial resolution, novel contrast imaging techniques allow detection of washed out lesions down to 3mm in size. CEUS characterizes focal liver lesions with a much higher diagnostic confidence than conventional US and is comparable to CT and MRI. CEUS also improves intraoperative tumor detection and characterization. Using time intensity analysis a change in contrast enhancement and kinetics helps in estimating tumor response to chemotherapy. CEUS is also used to monitor local ablation therapy and is a useful imaging tool to detect early tumor recurrence. **Gallbladder:** CEUS can be used to better visualize ulceration, perforation, and tumors of its wall. It thus helps in optimizing clinical management, including timing for surgery. CEUS does not affect renal or thyroid function and is therefore helpful in older patients and the preferred imaging technique in young patients and those with impaired renal function.

#### RC610C Contrast Ultrasound of Bowel

### Participants



Stephanie R. Wilson, MD, Calgary, AB (*Presenter*) Research Grant, Lantheus Medical Imaging, Inc; Equipment support, Siemens AG; Equipment support, Koninklijke Philips NV

#### **LEARNING OBJECTIVES**

1) Attendees will recognize the association of hypervascularity with inflammatory processes in the bowel on the basis of neoangiogenesis. 2) They will appreciate the value of CEUS of the bowel, with provision of both subjective and objective blood flow determinations, useful in determining disease activity and in assessing response to therapy. . 3) They will apply the common interpretations of time intensity curves to obtain peak enhancement and area under the curve information, recognizing their direct relationship to inflammatory disease with increasing parameters.

#### **ABSTRACT**

RC602

## PQI Education - How to Do It

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

ED

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

### Participants

David B. Larson, MD, MBA, Los Altos, CA (*Moderator*) Intellectual property license agreement, Bayer AG; Potential royalties, Bayer AG

### LEARNING OBJECTIVES

- 1) Understand basic approaches to teaching practicing radiologists and trainees the core elements of Practice Quality Improvement.
- 2) Be prepared to set up and run a basic PQI education program for a local radiology department or practice.

### ABSTRACT

Completion of Practice Quality Improvement (PQI) projects has now become a requirement of the American Board of Radiology (ABR) Maintenance of Certification program. QI education is also now required by the Accreditation Council for Graduate Medical Education as part of residency training, and QI-related material is now included in the ABR's core, certifying, and recertifying examinations. In this session, the authors will share how they provide didactic and practical training in QI methodology for both practicing radiologists and trainees within their departments.

### Sub-Events

#### RC602A A Team-based, Project-based Improvement Education Program

### Participants

David B. Larson, MD, MBA, Los Altos, CA (*Presenter*) Intellectual property license agreement, Bayer AG; Potential royalties, Bayer AG

### LEARNING OBJECTIVES

- 1) Be familiar with major elements of a team-based, project-based quality improvement education program.
- 2) Understand the major elements required to replicate such a program at one's own institution.

### ABSTRACT

We believe that the best way to learn quality improvement is to complete a successful improvement project in a structured mentored environment, in conjunction with a dedicated didactic curriculum. At our institution, we have developed a 20-week course in which multidisciplinary teams solve meaningful problems to significantly improve performance in the department. Projects are strongly supported by senior leadership, individuals are assigned specific team roles, knowledgeable coaches are assigned to each team, and education is delivered in a 'flipped classroom' model.

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David B. Larson, MD, MBA - 2014 Honored Educator

#### RC602B Teaching Quality Improvement Essentials to Future Leaders

### Participants

James R. Duncan, MD, PhD, Saint Louis, MO, ([duncanj@mir.wustl.edu](mailto:duncanj@mir.wustl.edu)) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

- 1) Define quality as it relates to key aspects of their daily work.
- 2) Describe three essential steps common to any data-driven quality improvement initiative.
- 3) Design a basic curriculum for teaching quality improvement skills.

### ABSTRACT

Radiology's future leaders must learn process improvement techniques so that they can better lead frontline teams as they conduct quality/safety improvement projects. With support from the RSNA Research and Education Foundation, we created a Radiology Improvement Leader Training Course. The course is now in its fourth year. It is based on the Institute for Healthcare Improvement's 9 month long Improvement Advisor program. This session will review the design and delivery of that course as well as other strategies for teaching quality improvement techniques.

#### RC602C Basics of the ABR/ACGME Curriculum for Quality Improvement and Non-interpretative Skills

### Participants

Gloria M. Salazar, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify the basic elements of Quality Improvement Training for residents required by the ABR. 2) Understand key principles of the CLER pathways to excellence in order to promote physician education in patient quality and safety.

#### **ABSTRACT**

In addition to clinical expertise, radiologists will require to have effective knowledge of quality improvement (QI) methods in order to deliver safe and high-quality patient care. The need for QI skills has been emphasized by the American Board of Radiology (ABR) non-interpretative curriculum for residents. In addition, through the Clinical Learning Environment Review (CLER) Pathways to Excellence Program, the ACGME endorses training in QI and patient safety as an integral part of the curriculum to prepare healthcare providers on how to address issues related to quality of care.

**3D Printing (Hands-on)**

Thursday, Dec. 3 8:30AM - 10:00AM Location: S401AB

**IN**

AMA PRA Category 1 Credits™: 1.50

ARRT Category A+ Credits: 1.50

**Participants**

Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Moderator*) Research Grant, Toshiba Corporation;  
 Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Presenter*) Research Grant, Toshiba Corporation;  
 Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose  
 Jonathan M. Morris, MD, Rochester, MN (*Presenter*) Nothing to Disclose  
 Dimitris Mitsouras, PhD, Boston, MA (*Presenter*) Research Grant, Toshiba Corporation; Speakers Bureau, Toshiba Corporation  
 Andreas Giannopoulos, MD, Boston, MA, (agiannopoulos1@partners.org) (*Presenter*) Nothing to Disclose  
 Nicole Wake, MS, New York, NY (*Presenter*) Nothing to Disclose  
 Peter C. Liacouras, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose  
 Thomas A. Foley, MD, Rochester, MN (*Presenter*) Nothing to Disclose  
 Kiaran P. McGee, PhD, Rochester, MN (*Presenter*) Nothing to Disclose  
 Michael W. Itagaki, MD, MBA, Seattle, WA (*Presenter*) Owner, Embodi3D, LLC  
 Shannon N. Zingula, MD, Rochester, MN (*Presenter*) Nothing to Disclose  
 Leonid Chepelev, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose  
 Adnan M. Sheikh, MD, Ottawa, ON (*Presenter*) Nothing to Disclose  
 AiLi Wang, Ottawa, ON (*Presenter*) Nothing to Disclose  
 Wilfred Dang, BS, Ottawa, ON (*Presenter*) Nothing to Disclose  
 Ekin P. Akyuz, BSc, Ottawa, ON (*Presenter*) Nothing to Disclose  
 Taryn Hodgdon, MD, Ottawa, ON (*Presenter*) Nothing to Disclose  
 Carlos H. Torres, MD, Ottawa, ON (*Presenter*) Nothing to Disclose  
 Anji Tang, Boston, MA (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Learn the Standard Tessellation Language (STL) file format that is used in 3D printing. 2) Be exposed to a software package to enable segmentation of DICOM images using semi-automated and manual segmentation algorithms, allowing the user to demarcate desired parts. The most commonly used tools are thresholding, region growing, and manual sculpting. 3) Learn refinement of an output STL output so that it can be optimized for accurate printing of the desired anatomy and pathology. This step uses Computer Aided Design (CAD) software is used to perform steps such as "wrapping" and "smoothing" to make the model more homogeneous.

**ABSTRACT**

"3D printing" refers to fabrication of a tangible object from a digital file by a 3D printer. Materials are deposited layer-by-layer and then fused to form the final object. There are several 3D printing technologies that share similarities but differ in speed, cost, and resolution of the product. Digital Imaging and Communications in Medicine (DICOM) image files cannot be used directly for 3D printing; further steps are necessary to make them readable by 3D printers. The purpose of this hands-on course is to convert a set of DICOM files into a 3D printed model through a series of simple steps. Some of the initial post-processing steps may be familiar to the radiologist, as they share common features with 3D visualization tools that are used for image post-processing tasks such as 3D volume rendering. However, some are relatively or completely new to radiologists, including the manipulation of files in Standard Tessellation Language (STL). It is the STL format that is read by the 3D printer and used to output the hand held part of the patient's anatomy. This 90 minute session will begin with a DICOM file and will proceed through the steps to create a printable STL file. An extensive training manual will be provided before the meeting. It is highly recommended that participants review the training manual to optimize the experience at the workstation.

**URL****Active Handout: Frank John Rybicki**[http://abstract.rsna.org/uploads/2015/14003458/Active RCA13.pdf](http://abstract.rsna.org/uploads/2015/14003458/Active_RCA13.pdf)

## The Role of Advanced Imaging in Unraveling the Secrets of Ancient Art and Artifacts

Thursday, Dec. 3 8:30AM - 10:00AM Location: S404AB

OT

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

### Participants

Barry D. Daly, MD, Baltimore, MD, (bdaly@umm.edu) (*Moderator*) Research Grant, Koninklijke Philips NV  
Barry D. Daly, MD, Baltimore, MD, (bdaly@umm.edu) (*Presenter*) Research Grant, Koninklijke Philips NV  
Vahid Yaghmai, MD, Chicago, IL, (v-yaghmai@northwestern.edu) (*Presenter*) Nothing to Disclose  
Jonathan P. Brown, MS, Chicago, IL (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To describe the novel use of advanced imaging techniques in the non-invasive investigation of historic art treasures. 2) To identify related benefits for both research and educational activities at museums and art institutions.

### ABSTRACT

In recent years museums worldwide have sought to partner with radiology departments in the non-invasive investigation of ancient and fragile treasures. Advanced digital imaging and 3D CT have been used to determine the age, authenticity, composition and geographic origin of these artifacts, to investigate their internal contents, and to detect prior structural damage and hidden repairs. The subject material of this course includes a diverse range of significant artifacts such as Egyptian and Peruvian mummies, Mesoamerican and Chinese ceramics, Mesopotamian stucco art, Judaic tabernacles, European medieval religious artifacts, Renaissance paintings, Stradivarius violins and Japanese wood sculptures. Some conservators now have access to 3D imaging software at museums or may conduct remote collaborative analysis of cases with radiologists via cloud-based 3D servers. The speakers include two radiologists with extensive experience in the technical approach to imaging these treasures and a senior conservator at the Field museum who will provide an expert's perspective on the research and educational value of the findings.

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Vahid Yaghmai, MD - 2012 Honored Educator  
Vahid Yaghmai, MD - 2015 Honored Educator

RC627

## Challenges in Imaging Economics: Perspectives from Three Nations: Canada, UK and USA

Thursday, Dec. 3 8:30AM - 10:00AM Location: S404CD

HP

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

### Participants

Frank J. Lexa, MD, Philadelphia, PA (*Coordinator*) Nothing to Disclose

Frank J. Lexa, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Geraldine B. McGinty, MD,MBA, New York, NY (*Presenter*) Nothing to Disclose

Bruce B. Forster, MD, Vancouver, BC (*Presenter*) Travel support, Siemens AG; Travel support, Toshiba Corporation;

Erika R. Denton, MBBS, Norwich, United Kingdom (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Examine the drivers of change in radiology in three nations. 2) Compare and contrast the challenges that radiology faces globally. 3) Understand how organized radiology is adapting to a rapidly changing societal landscape for its services. 4) Analyze best practices for handling the challenges that we all face.

### ABSTRACT

Radiologists in many parts of the globe are experiencing rapid changes in the way that they practice their specialty. The drivers of change and the challenges that they create are legion. In this session, we will have distinguished speakers from three nations discuss the challenges that organized radiology faces in their home countries and how they have tried to adapt in these circumstances. The topics will include a wide ranging array of strategic considerations including but not limited to: aging patient populations, rising demand for healthcare, changing government regulation, methods of payment in the public (and where appropriate the private) sector, regulatory issues, radiologist workforce issues and the training of the next generation of radiologists. The session will encompass both presentations and a panel discussion which will be informative and provocative

MSCS51

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

Thursday, Dec. 3 8:30AM - 10:00AM Location: S406A

MK

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

### Participants

Lynne S. Steinbach, MD, San Francisco, CA, (lynne.steinbach@ucsf.edu) (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify the application of basic anatomic, pathologic, and physiologic principles to specific disease processes that affect the muscles, shoulder, elbow, wrist and hand. 2) Illustrate using case examples of several important disease processes that affect these regions, using several imaging methods and emphasizing the value of each. 3) Present the major teaching points and differential diagnostic considerations for each of the chosen cases and, when appropriate, clarify the importance of early accurate diagnosis.

### ABSTRACT

Accurate diagnosis of many disorders that affect muscles, shoulder, elbow, wrist and hand can be accomplished with basic or advanced imaging methods, or both. A series of cases will be used to illustrate a few of these disorders, with attention to the most appropriate imaging protocol, the salient imaging findings, the anatomic and pathophysiologic factors that explain the findings, and the important differential.

### Sub-Events

#### MSCS51A Muscle

### Participants

Andrew J. Grainger, MRCP, FRCR, Leeds, United Kingdom (*Presenter*) Speaker, General Electric Company; Equipment support, Siemens AG;

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### MSCS51B Shoulder

### Participants

Jenny T. Bencardino, MD, New York, NY (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### Handout: Jenny T. Bencardino

[http://abstract.rsna.org/uploads/2015/15002740/Bencardino\\_Shoulder\[1\].pdf](http://abstract.rsna.org/uploads/2015/15002740/Bencardino_Shoulder[1].pdf)

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Jenny T. Bencardino, MD - 2014 Honored Educator

#### MSCS51C Elbow

### Participants

Kathryn J. Stevens, MD, Menlo Park, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### MSCS51D Wrist and Hand

### Participants

Leon Lenchik, MD, Winston-Salem, NC, (llenchik@wakehealth.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

RC613

## Peds Neuro

Thursday, Dec. 3 8:30AM - 10:00AM Location: E350



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

### Participants

#### Sub-Events

#### **RC613A Imaging of Sensorineural Hearing Loss in Children**

##### Participants

Maura E. Ryan, MD, Chicago, IL, (mryan@luriechildrens.org) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) Review pertinent anatomy of the inner ear structures. 2) Describe pathologic CT and MRI findings of the inner ear, membranous labyrinth and cochlear nerve associated with pediatric sensorineural hearing loss.

**Active Handout:**Maura E. Ryan

[http://abstract.rsna.org/uploads/2015/15002058/RC613A\\_MR.pdf](http://abstract.rsna.org/uploads/2015/15002058/RC613A_MR.pdf)

#### **RC613B Imaging Approach to Seizures in Children**

##### Participants

Luke L. Linscott, MD, Cincinnati, OH, (luke.linscott@cchmc.org) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) Identify major causes of seizures in children. 2) Understand importance of optimal MR imaging technique for epilepsy evaluation.

#### **RC613C Perinatal Imaging of Congenital Posterior Fossa Anomalies**

##### Participants

Ashley J. Robinson, MBChB, Doha, Qatar, (ASH@RADIOLOGIST.NET) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) Revise the relevant embryology of the posterior fossa, including the brainstem, cerebellum and cisterna magna. 2) Review several criteria for evaluation of congenital posterior fossa anomalies using a case-based approach.

##### ABSTRACT

**Active Handout:**Ashley James Robinson

<http://abstract.rsna.org/uploads/2015/15002062/RC613C.pdf>



RC604

## Multimodality Evaluation of Joint Replacements: A Master Class (An Interactive Session)

Thursday, Dec. 3 8:30AM - 10:00AM Location: E353B

MK

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

### Participants

Theodore T. Miller, MD, New York, NY (*Director*) Nothing to Disclose

### Sub-Events

#### RC604A Hip and Knee

### Participants

Theodore T. Miller, MD, New York, NY (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Apply the technique for MR imaging of hip and knee replacements. 2) Recognize and describe the MR appearances of complications related to these joint replacements.

### ABSTRACT

MR imaging of hip and knee replacements requires adjustment of scanning parameters, such as using fast spin echo sequences with long echo train length, maximum receiver bandwidth, thin slices, and a high frequency-encoding matrix, to minimize intravoxel dephasing and misregistration artifacts. Proprietary techniques such as MAVRIC (multi-acquisition variable resonance image combination) and SEMAC (slice-encoding metal artifact correction) can also reduce metal-related artifacts. Complications encountered on MR imaging of hip and knee replacements will be discussed, including adverse reactions to metal debris, polymeric wear, infection, osteolysis, component loosening, stress reaction and fracture, and tendon tears.

#### RC604B Shoulder and Elbow

### Participants

Felix S. Chew, MD, Seattle, WA, (fchew@uw.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Recognize and describe the features of shoulder joint replacements on radiologic images. 2) Recognize and describe the features of elbow joint replacements on radiologic images.

### ABSTRACT

Shoulder joint replacements include anatomic total joint replacements, humeral head replacements, and reverse total joint replacements. Elbow joint replacements include replacements of the radial head alone, replacements of the radiocapitellar compartment, and replacements of the ulno-trochlear compartment. Knowledge of the expected appearances of each type of postsurgical construct and the range of complications will improve the radiologist's ability to identify complications.

### Active Handout:Felix Sze-Kway Chew

[http://abstract.rsna.org/uploads/2015/15001714/Active RC604B.pdf](http://abstract.rsna.org/uploads/2015/15001714/Active_RC604B.pdf)

### Honored Educators

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Felix S. Chew, MD - 2012 Honored Educator

#### RC604C Smaller Joints

### Participants

Laura W. Bancroft, MD, Orlando, FL, (laura.bancroft.md@flhosp.org) (*Presenter*) Royalties, Wolters Kluwer nv

### LEARNING OBJECTIVES

1) Review imaging characteristics of arthroplasties in smaller joints, such as the ankle/foot, hands/feet and elbow. 2) Demonstrate complications of smaller joint arthroplasties with various imaging modalities.

### ABSTRACT

This refresher course will encompass the imaging characteristics of arthroplasties in smaller joints, such as the ankle/foot, hands/feet and elbow. The normal appearances and complications of smaller joint arthroplasties will be demonstrated utilizing various imaging modalities.

**US for Thyroid Cancer: Diagnosis, Surveillance, and Treatment**

Thursday, Dec. 3 8:30AM - 10:00AM Location: E351



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

**Participants**

Jill E. Langer, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose  
Kathryn A. Robinson, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose  
Sheila Sheth, MD, Cockeysville, MD, (ssheth@jhmi.edu) (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the sonographic characteristics of thyroid nodules that are suspicious for malignancy. 2) a. Discuss the Bethesda Cytology Classification of Thyroid FNA results and the risk of malignancy associated with each category. b. Describe the indications for two new genetic tests that may be performed on FNAs obtained from thyroid nodules with indeterminate cytology. 3) a. Describe the technique of US-guided biopsy of thyroid nodules and cervical lymph nodes in patients who have undergone thyroidectomy for thyroid cancer. b. Discuss the rationale and method of performance of US-guided ethanol ablation of malignant cervical adenopathy in post thyroidectomy patients.

**ABSTRACT**

This presentation will consist of a three individual presentations. The first will review the sonographic characteristics of thyroid nodules that are suggestive of malignancy. Recommendations for selecting which thyroid nodules require ultrasound-guided biopsies which have been provided by both Radiology consensus conferences and published Endocrinology guidelines will be discussed. The second presentation will review with the Bethesda Cytology Classification of Thyroid FNA results and the risk of malignancy associated with each category. Additionally this presentation describes the indications for two new genetic tests that may be performed on FNAs obtained from thyroid nodules with indeterminate cytology. The last presentation will provide a detailed description of the technique for performing ultrasound guided biopsy of thyroid nodules and cervical lymph nodes. Various methods will be discussed and required equipment outlined. Possible complications, though rare, will be described. A comparison of the typical sonographic features of normal versus abnormal lymph nodes will be presented in an effort to identify those patients in whom sonographic follow up can be used instead of biopsy. A discussion of the possible advantages of adding thyroglobulin assay to cytologic evaluation will be provided. The rationale for and technique of performing ultrasound guided ethanol ablation of malignant cervical lymph nodes in patients with thyroid cancer will be undertaken.

RC607

## A Case-based Audience Participation Session (Genitourinary) (An Interactive Session)

Thursday, Dec. 3 8:30AM - 10:00AM Location: E352

GU

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

### Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Coordinator*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Medical Advisory Board, Merge Healthcare Incorporated  
William W. Mayo-Smith, MD, Boston, MA (*Presenter*) Author with royalties, Reed Elsevier; Author with royalties, Cambridge University Press  
Andrea G. Rockall, MRCP, FRCR, London, United Kingdom (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) The participant will be introduced to a series of Genitourinary 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 Genitourinary 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. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

### ABSTRACT

The extremely popular audience participation educational experience is back! :GU Diagnosis Live is an expert-moderated session featuring a series of interactive Genitourinary case studies that will challenge radiologists' diagnostic skills and knowledge. Building on last year's successful Diagnosis Live premiere, GU Diagnosis Live is a lively, fast-paced game format: participants will be automatically assigned to teams who will then use their personal mobile devices to test their knowledge of GU radiology in a fast-paced session that will be both educational and entertaining. After the session, attendees 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. :

RC618

## Interactive Quiz Cases in Body Oncologic Imaging (An Interactive Session)

Thursday, Dec. 3 8:30AM - 10:00AM Location: E353A

OI

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

### Participants

#### LEARNING OBJECTIVES

Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

### Sub-Events

#### RC618A Chest Masses

### Participants

Cristina Fuss, MD, Portland, OR, (fussc@ohsu.edu) (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Describe characteristic imaging features of malignant chest masses. 2) Characterize benign pulmonary masses that may mimic malignancies. 3) Describe common imaging pitfalls in differentiating benign from malignant masses. 4) Determine the need for further imaging vs. invasive procedures of pulmonary masses depending on their imaging appearance.

#### 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.

#### RC618B Abdominal Masses

### Participants

Chandana G. Lall, MD, Orange, CA (*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 4. Logical work up of lesions; further imaging and need for intervention

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Chandana G. Lall, MD - 2013 Honored Educator

#### RC618C MSK/Soft Tissue Masses

### Participants

Sandra Schmahmann, MD, Portland, OR, (schmahma@ohsu.edu) (*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.

RC615

## BI-RADS (An Interactive Session)

Thursday, Dec. 3 8:30AM - 10:00AM Location: E450A

**BR** **DM** **MR** **US**

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

### Participants

### Sub-Events

#### RC615A **BI-RADS: Mammography**

#### Participants

Edward A. Sickles, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Understand and use the new approach to classifying breast density. 2) Properly use current BI-RADS assessment categories. 3) Report discordances between assessment category and management recommendation.

#### RC615B **Ultrasound**

#### Participants

Ellen B. Mendelson, MD, Chicago, IL (*Presenter*) Medical Advisory Board, Delphinus Medical Technologies, Inc; Research support, Siemens AG; Consultant, Siemens AG; Speaker, Siemens AG; Medical Advisory Board, Quantason, LLC; Consultant, Quantason, LLC;

#### LEARNING OBJECTIVES

At the conclusion of this session on BI-RADS for US, learners will be able to 1. Understand inseparability of image quality and interpretability. 2. Assess breast masses using a trio of feature categories: shape, margin, orientation. 3. Apply the principle of multiple benign masses to address low PPV's of breast US. 4. Recognize architectural distortion and other Associated Features.

#### ABSTRACT

#### RC615C **MRI**

#### Participants

Elizabeth A. Morris, MD, New York, NY (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Understand the new MRI BI-RADS® descriptors including background parenchymal enhancement (BPE). 2) Properly apply the Final Assessment categories, particularly BI-RADS® 0 for MRI. 3) Apply the audit recommendations to your breast MRI practice.

RC629

## Prostate MRI Using PI-RADS (Prostate Imaging Reporting and Data System) (An Interactive Session)

Thursday, Dec. 3 8:30AM - 10:00AM Location: E450B



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

### Participants

#### 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-PI-RADS methodology. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

### Sub-Events

#### RC629A Introduction to PI-RADS

Participants

Jeffrey C. Weinreb, MD, New Haven, CT (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.

#### RC629B Technical Considerations

Participants

Clare M. Tempany-Afdhal, MD, Boston, MA (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.

#### RC629C How to Use PI-RADS

Participants

Jelle O. Barentsz, MD, PhD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.

**Active Handout:** [Jelle O. Barentsz](#)

[http://abstract.rsna.org/uploads/2015/14000510/Active RC629C.pdf](http://abstract.rsna.org/uploads/2015/14000510/Active_RC629C.pdf)

#### RC629D Interactive Clinical Case Review

Participants

#### LEARNING OBJECTIVES

View learning objectives under main course title.

RC609

## Liver Lesions

Thursday, Dec. 3 8:30AM - 10:00AM Location: E353C

**GI**

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

### Participants

### Sub-Events

#### RC609A Hypervascular Liver Lesions in non-Cirrhotic Patients

### Participants

David J. Grand, MD, Providence, RI (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Confidently diagnose liver lesions that meet imaging criteria as definitively benign. 2) Describe the use of hepatocyte-specific contrast agents and their role in evaluation of hypervascular liver lesions. 3) Provide a differential diagnosis for hypervascular lesions which are not definitively benign and recommend further imaging or biopsy as appropriate.

#### RC609B Dealing with Liver Incidentalomas

### Participants

Rajan T. Gupta, MD, Durham, NC, (rajan.gupta@duke.edu) (*Presenter*) Consultant, Bayer AG; Speakers Bureau, Bayer AG; Consultant, Invivo Corporation

### LEARNING OBJECTIVES

1) The goal of this course is to familiarize the audience with recent work on dealing with liver incidentalomas including recommendations from the ACR white paper on the topic. Case examples with management guidelines will be shown to demonstrate the key elements of these papers.

#### RC609C HCC - Typical and Atypical

### Participants

Choon H. Thng, MBBS, Singapore, Singapore, (thng.choon.hua@singhealth.com.sg) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify typical appearances of HCC on CT and MRI. 2) Describe and apply criteria from AASLD consensus conference for imaging-based diagnosis of HCC. 3) Identify atypical appearances of HCC and recommend appropriate additional diagnostic procedures for these lesions.

### ABSTRACT

Hepatocellular carcinoma (HCC) commonly occurs in cirrhotic liver and has typical appearances of arterial enhancement and wash-out in the delayed phase. Consensus conferences such as the American Association for Study of Liver Diseases (AASLD) have set up diagnostic criteria based on these typical appearances, for which an imaging-based diagnosis of HCC can be made. However, the appearances of HCC can be atypical when the above findings are less obvious. Arterial hypervascularity can be inferred when a lesion enhances from hypointensity in the pre contrast phase to isointensity in the arterial phase. Subtle arterial hypervascularity and wash-out can also be inferred by comparing changes in signal intensity and Hounsfield readings of the lesion as well as the background liver. The presence of fibrous septa, mosaic pattern, and nodule-in-nodule architecture are suggestive of HCC. Organic anionic transporting polypeptide (OATP) expression declines during the carcinogenesis process and hepatocyte specific contrast allows early detection of HCC nodules which have yet to show the typical patterns. Moderate T2 hyperintensity and restricted diffusion favor the diagnosis of malignancy but are not specific for HCC. They are useful in suggesting the possibility of HCC when observed in the appropriate context of gadolinium enhanced or hepatocyte specific contrast enhanced MR studies. HCC can rarely present in atypical forms for which a diagnosis cannot be made without histology. Understanding the typical and atypical appearances of HCC allow the radiologist to actively participate in the management of the patient.

#### RC609D Imaging after Liver-directed Therapy

### Participants

Steven S. Raman, MD, Santa Monica, CA (*Presenter*) Nothing to Disclose



RC621

## Medical Physics 2.0: Magnetic Resonance Imaging

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



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

### Participants

Ehsan Samei, PhD, Durham, NC (*Director*) Nothing to Disclose  
Douglas E. Pfeiffer, MS, Boulder, CO (*Director*) Nothing to Disclose

### Sub-Events

#### RC621A Magnetic Resonance Imaging Perspective

##### Participants

Douglas E. Pfeiffer, MS, Boulder, CO (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

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

##### ABSTRACT

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

#### RC621B Magnetic Resonance Imaging 1.0

##### Participants

Ronald Price, PhD, Nashville, TN (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

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

##### ABSTRACT

MRI 1.0: Magnetic Resonance Imaging Ronald R. Price The purpose of this presentation is to review the current role of the medical physicist in clinical Magnetic Resonance Imaging (MRI). The discussion will first discuss MRI acceptance testing with reference to the recommendations of AAPM Report No. 100 and will specifically include items that should be part of both the initial and annual MRI safety survey. This discussion will be followed by a review of the image quality metrics that are currently used as part of an MRI system performance report as well as how the medical physicist may go about assisting in the development and evaluation of imaging sequences used as part of clinical protocols. The presentation will also discuss the steps necessary for establishing and maintaining a routine quality assurance program with emphasis on the necessity of establishing a strong working relationship with the MRI quality assurance technologist. There will also be a review of the system specific requirements for MRI accreditation.

#### RC621C Magnetic Resonance Imaging 2.0

##### Participants

David R. Pickens III, PhD, Nashville, TN (*Presenter*) Stockholder, Johnson & Johnson

##### LEARNING OBJECTIVES

1) Identify requirements for improving quality assurance and compliance tools for advanced and hybrid MRI systems. 2) Identify the need for new quality assurance metrics and testing procedures for advanced systems. 3) Identify new hardware systems and new procedures needed to evaluate these systems. 4) Understand safety concerns for personnel and patients from advanced systems. 5) Recognize the importance of the medical physicist in the clinical testing, safety evaluations, and use of these systems.

##### ABSTRACT

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

RC606

## Open Wide! Imaging the Oral Cavity and Jaw

Thursday, Dec. 3 8:30AM - 10:00AM Location: E451B



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

### Participants

### Sub-Events

#### RC606A Odontogenic and Non-odontogenic Diseases of the Jaw

### Participants

Joel K. Cure, MD, Birmingham, AL, (jcure@uabmc.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Perform technically optimized CT examinations to evaluate jaw lesions. 2) Identify imaging features that predict an odontogenic vs. non-odontogenic origin of imaged jaw lesions. 3) Stratify a differential diagnosis for jaw lesions by employing principles conveyed in this presentation. 4) Identify cases requiring clinical action.

### ABSTRACT

After considering the clinical presentation and patient demographics, a differential diagnosis for imaged jaw lesions is facilitated by optimized imaging and identification of features that predict an odontogenic vs. non-odontogenic lesion origin and that predict lesion behavior. Location of the lesion in tooth-bearing vs. non-tooth-bearing portions of the jaw, the spatial relationship of the lesion to individual teeth, and the condition of the affected/involved dentition are all noteworthy features. Analysis of lesion attenuation, margins, growth patterns, and soft tissue components can help discriminate similar-appearing lesions and inform patient management.

#### RC606B Benign Oral Cavity Disease

### Participants

Kristen L. Baugnon, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Differentiate the spaces of the oral cavity and develop a differential diagnosis for lesions arising in those locations. 2) Identify some of the most frequently encountered benign lesions in the oral cavity, including anatomic variant, infectious/inflammatory, developmental, and benign neoplastic lesions. 3) Recommend optimal imaging techniques for detection of oral cavity pathology.

### ABSTRACT

Benign lesions in the oral cavity can often be detected incidentally on imaging, and can present a diagnostic challenge. The imaging findings of the most frequently encountered benign lesions in the oral cavity are depicted, including anatomic variants, infectious/inflammatory, developmental, and benign neoplastic lesions. The spaces of the oral cavity, including the root of the tongue, sublingual space, and submandibular space are reviewed, and a systematic approach to assessing lesions occurring in these locations is presented. CT and MRI imaging techniques and pitfalls in imaging the oral cavity are discussed.

### Active Handout:Kristen Lloyd Baugnon

[http://abstract.rsna.org/uploads/2015/15001973/RC606B Benign oral cavity disease.KLB.handout.updated.pdf](http://abstract.rsna.org/uploads/2015/15001973/RC606B%20Benign%20oral%20cavity%20disease.KLB.handout.updated.pdf)

#### RC606C Malignant Oral Cavity Disease

### Participants

Kristine M. Mosier, DMD, PhD, Indianapolis, IN (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To be familiar with the most common malignant neoplasms of the oral cavity and the key elements for differential diagnosis. 2) To understand staging of oral cavity cancer and be familiar with the critical elements for accurate staging.

### ABSTRACT

In this session we will review the most common oral cavity malignant neoplasms with practice pearls to help guide the differential diagnoses of these lesions, as well as less common lesions. We will review current staging for oral cavity cancer and identify those key anatomical features critical to staging. Finally we will review spread patterns for oral cavity cancer.

**Emergency Radiology Series: Contemporary Topics in Imaging of Trauma**

Thursday, Dec. 3 8:30AM - 12:00PM Location: S405AB



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

**Participants**

Scott D. Steenburg, MD, Zionsville, IN, (ssteenbu@iuhealth.org) (*Moderator*) Nothing to Disclose  
Savvas Nicolaou, MD, Vancouver, BC (*Moderator*) Institutional research agreement, Siemens AG  
Martin L. Gunn, MBChB, Seattle, WA, (marting@uw.edu) (*Moderator*) Research support, Koninklijke Philips NV; Spouse, Consultant, Wolters Kluwer NV; Medical Advisor, TransformativeMed, Inc;

**Sub-Events****RC608-01 Current Issues in Trauma CT Protocols**

Thursday, Dec. 3 8:30AM - 8:55AM Location: S405AB

**Participants**

Martin L. Gunn, MBChB, Seattle, WA, (marting@uw.edu) (*Presenter*) Research support, Koninklijke Philips NV; Spouse, Consultant, Wolters Kluwer NV; Medical Advisor, TransformativeMed, Inc;

**LEARNING OBJECTIVES**

1) Summarize challenges that are encountered when performing trauma CT in the ED. 2) Identify tradeoffs that are encountered when deciding 'who' to scan and 'how' to scan. 3) Understand CT techniques that can be used to optimize radiation dose, contrast use, workflow, and injury detection.

**ABSTRACT****RC608-02 Is There Any Prognostic Biomarker of Computed Tomography (CT) Images in Patients with Blunt Trauma?: A Single Trauma Center's Experience**

Thursday, Dec. 3 8:55AM - 9:05AM Location: S405AB

**Participants**

Yasutaka Baba, MD, Hiroshima, Japan (*Presenter*) Nothing to Disclose  
Masaki Ishikawa, MD, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose  
Kenji Kajiwara, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose  
Wataru Fukumoto, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose  
Kazuo Awai, MD, Hiroshima, Japan (*Abstract Co-Author*) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Medical Advisor, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Nemoto-Kyourindo; ; ; ;

**PURPOSE**

To investigate the prognostic biomarker of CT images in patients with blunt trauma.

**METHOD AND MATERIALS**

From April 2014 to March 2015, 1077 patients (pts) were admitted to ER (emergency room) unit of our hospital. Among them, total 89 traumatized patients (male 58 pts, female 31 pts, average age 57.6 year-old) who underwent biphasic contrast enhanced CT were enrolled in this study. The causes of trauma were motor vehicle accident (MVA) in 52 pts, fallen accident in 26 pts, stab wound in 3 pts, and others in 8 pts. Radiological and surgical interventional treatments were performed in 10 pts and in 42 pts, respectively. Patient's status, laboratory data, blunt trauma associated score and CT signs as prognostic biomarker were statistically correlated with the mortality.

**RESULTS**

Among the patient's status, laboratory data, blunt trauma associated score, there was a statistically significant correlation between the mortality and low maximal blood pressure ( $p=0.0041$ ), tachycardia ( $p=0.0236$ ), low sPO<sub>2</sub> ( $p<0.0001$ ), low scores of GCS (Glasgow Coma Scale) ( $p=0.0014$ ), high scores of injury severity score (ISS) ( $p<0.0001$ ), low serum hemoglobin level ( $p=0.0254$ ), base excess ( $p=0.0002$ ), and chest blunt trauma ( $p=0.0155$ ). Meanwhile, among the CT signs as prognostic biomarker, there was a statistically significant correlation between the mortality and the intense adrenal enhancement (IAE) at early phase ( $p<0.0001$ ), the flattening of the inferior vena cava (FIVC) ( $p=0.0016$ ) and the shock bowel ( $p=0.0058$ ).

**CONCLUSION**

It is important to recognize not only the patient's derived information but also the IAE, FIVC and shock bowel as predictive biomarker on biphasic CT images in patients with blunt trauma because the early intervention is required.

**CLINICAL RELEVANCE/APPLICATION**

Biphasic CT images could provide the information of critically ill patients with blunt trauma and lead us to share decision-making in the treatment.

**RC608-03 Pelvic Angiography Project ASER (PAPA) Study - A Retrospective Multicenter Cohort Study of Blunt Pelvic Trauma Patients Who Undergo Catheter Angiography**

Thursday, Dec. 3 9:05AM - 9:15AM Location: S405AB

## Participants

Ken F. Linnau, MD, MS, Seattle, WA (*Presenter*) Speaker, Siemens AG; Royalties, Cambridge University Press;  
Bharti Khurana, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Daniel S. Hippe, MS, Seattle, WA (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company  
Kellie L. Sheehan, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose  
Jorge A. Soto, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
David Dreizin, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Matthew T. Heller, MD, Pittsburgh, PA (*Abstract Co-Author*) Consultant, Reed Elsevier; Author, Reed Elsevier  
Keith D. Herr, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Scott D. Steenburg, MD, Zionsville, IN (*Abstract Co-Author*) Nothing to Disclose  
Tarek N. Hanna, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose  
David J. Nickels, MD, Lexington, KY (*Abstract Co-Author*) Nothing to Disclose  
Hani H. Abujudeh, MD, MBA, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Savvas Nicolaou, MD, Vancouver, BC (*Abstract Co-Author*) Institutional research agreement, Siemens AG  
Christina A. LeBedis, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Ludo F. Beenen, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To assess triage pathways and imaging findings in blunt pelvic trauma patients who underwent catheter angiography and establish practice pattern variation and effectiveness of CECT.

## METHOD AND MATERIALS

This retrospective multicenter cohort study from 12 level-1-trauma centers in the United States, Canada and Europe included victims of blunt trauma with pelvic fracture and subsequent conventional catheter angiography for treatment of arterial bleeding. Patient data including demographics, clinical and imaging variables prior to angiography was abstracted at each center and sent to a central data repository. Triage algorithms and imaging protocols of each participating center were obtained through a web-based survey. Descriptive, univariate and multivariate analysis was performed. Mixed-effects multivariate logistic regression analysis which accounted for site heterogeneity was performed.

## RESULTS

813 patients (37% women, median age 50 yrs, 24% > 65 yrs, 25% transfers) from 2009 to 2013 were included. The median Injury Severity Score (ISS) was 34 with most injuries due to motor vehicles. Overall, 61 (7.5 %) patients died within 24 hrs of admission. Imaging work-up varied with 3 of 12 centers always performing CECT prior to conventional angiography. Pelvic radiographs were obtained in 88% patients and 62% had FAST during initial resuscitation. CECT was obtained in 77% of patients before angiography. ISS was significantly higher in those who had no CECT (39 vs 33). Door-to-angio time was 3.8 hrs. Overall, 69% of patients had catheter angiographic findings of any arterial injury, 55% had active contrast extravasation. The positive angio rate was 67% if CECT was obtained and 76% if no CECT was done before angiography ( $p = 0.024$ ). Site-adjusted multivariate logistic regression accounting for laparotomy, pelvic binder, pelvic packing, any transfusions, HR >120, hematocrit revealed an odds ratio for positive angiography of 0.83 (CI: 0.53-1.31,  $p = 0.42$ ) if CECT was obtained.

## CONCLUSION

Although CECT is widely utilized, the rate of arterial vascular injury on conventional catheter angiography is not substantially different in blunt pelvic trauma patients who do not get CECT before intervention.

## CLINICAL RELEVANCE/APPLICATION

Although catheter angiography is recommended in hemodynamically unstable patients with pelvic fractures, it remains unclear if contrast-enhanced computed tomography (CECT) aids in triage of such patients to angiography.

## Honored Educators

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Bharti Khurana, MD - 2014 Honored Educator  
Jorge A. Soto, MD - 2013 Honored Educator  
Jorge A. Soto, MD - 2014 Honored Educator  
Jorge A. Soto, MD - 2015 Honored Educator

## RC608-04 CT of Neck Injuries

Thursday, Dec. 3 9:15AM - 9:40AM Location: S405AB

## Participants

Clint W. Sliker, MD, Ellicott City, MD (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1) Recognize the imaging appearances of injuries to a number of important neck structures other than the spine and cerebrovasculature, including the larynx, pharynx, trachea, esophagus, and external carotid artery branches. 2) Understand the limitations and pitfalls of CT when used to diagnose injuries to these structures.

## ABSTRACT

**Active Handout: Clint W. Sliker**

<http://abstract.rsna.org/uploads/2015/15003328/RC608-04.pdf>

## RC608-05 Immediate Total-body CT Scanning versus Conventional Imaging and Selective CT Scanning in Severe Trauma Patients: A Randomised Controlled Trial (REACT-2 Trial)

Thursday, Dec. 3 9:40AM - 9:50AM Location: S405AB

### Participants

Joanne C. Sierink, MD, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Kaij Treskes, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Ludo F. Beenen, MD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose  
Joachim Hohmann, MD, DIPLOPHYS, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Michael J. Edwards, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Benn J. Beuker, MD, PhD, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Dennis den Hartog, MD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Marcel Dijkgraaf, PHD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Jan S. Luitse, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Markus W. Hollmann, MD, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Carel Goslings, MD, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Recent literature suggests a survival benefit for trauma patients when they are evaluated with total-body Computed Tomography (TBCT) scanning during the initial trauma evaluation. Since level-1 evidence is lacking this study aimed to assess the value of immediate total-body CT scanning in severely injured trauma patients.

### METHOD AND MATERIALS

In this multicentre clinical trial, we randomly assigned 541 trauma patients to immediate TBCT scanning and 542 patients to the standard workup with conventional imaging supplemented with selective CT scanning. Trauma patients having compromised vital parameters, clinical suspicion of life-threatening injuries or severe injury mechanisms were eligible. The primary endpoint was in-hospital mortality. Secondary endpoints were clinically relevant time intervals, radiation exposure, missed injuries and direct medical costs.

### RESULTS

The in-hospital mortality rate was not statistically different between groups (TBCT 15.9% vs. standard 15.7%,  $P=0.923$ ). Subgroup analyses in polytrauma patients also did not reveal a significant difference between groups (TBCT 22.4% vs. standard 24.8%,  $P=0.457$ ). Imaging time in the trauma room was decreased in the TBCT group (30 min vs. 37 min,  $P<0.001$ ). More patients in the standard workup group received a lower effective radiation dose during the total hospital stay (21.0mSv [IQR=20.9-25.2] versus 20.6mSv [IQR=11.8-27.6],  $P<0.001$ ). The number of missed injuries found during the tertiary survey were not different between groups (45 [8.8%] vs. 53 [10.1%],  $P=0.448$ ). The medical costs were €24,967 (95% CI: €21,880- €28,752) for the TBCT group and €26,995 (95% CI: €23,326-€30,908) for the standard workup group ( $P=0.439$ ).

### CONCLUSION

Total-body CT scanning was safe, shortened the imaging time and did not increase the medical costs, but it did not improve survival, and most patients in the standard workup group received a lower radiation dose.

### CLINICAL RELEVANCE/APPLICATION

Total-body Computed Tomography can be used for evaluation in trauma as it is safe and fast. Further research should focus on improvement of selection of trauma patients for evaluation by TBCT scanning.

## RC608-06 Utility of MDCT Findings in Predicting Patient Management Outcomes in Renal Trauma

Thursday, Dec. 3 9:50AM - 10:00AM Location: S405AB

### Participants

Arthur Baghdanian, MD, Boston, MA (*Presenter*) Nothing to Disclose  
Armonde Baghdanian, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Anthony S. Armetta, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Christina A. LeBedis, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Jorge A. Soto, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Stephan W. Anderson, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To assess the utility of MDCT findings in predicting clinical outcomes in renal trauma.

### METHOD AND MATERIALS

This retrospective study was IRB approved and HIPAA compliant; informed consent was waived. Adult patients suffering from blunt or penetrating renal trauma from 01/01/2006 to 12/31/2013 were included. During this interval, 162 patients met this inclusion criteria (males,  $n=121$ ; females,  $n=41$ ; mean age = 33 years-old, range 15-88 years; blunt trauma,  $n=114$ ; penetrating trauma,  $n=48$ ). Renal injury was graded based on the AAST kidney injury scale. Additional variables that were blind read from abdominopelvic CT studies as well as recorded from the EMR included: active extravasation, collecting system injury, embolization, collecting system stenting and surgical management. Fisher's exact test was used to evaluate the association between: active extravasation and operative or endovascular therapy; AAST score and operative or endovascular therapy; and AAST score and collecting system stenting.

### RESULTS

AAST kidney injury score: grade 1 ( $n=26$ ), grade 2 ( $n=33$ ), grade 3 ( $n=61$ ), grade 4 ( $n=37$ ), and grade 5 ( $n=5$ ). Active extravasation ( $n=25$ ) and collecting system injury ( $n=20$ ). 13/162 (8%) patients received further management related to renal trauma. 2 patients (1%) required renal artery embolization. 11 patients underwent surgery: nephrectomy ( $n=2$ ; 1%), renorrhaphy ( $n=3$ ; 2%), and collecting system stent ( $n=6$ ; 3.7%). 7/25 patients (13/25 grade 3/4; 12/25 grade 1/2/3) with active extravasation received surgical management or embolization. There was a statistically significant correlation between active extravasation and

surgical or endovascular therapy ( $p < 0.001$ ). There was a statistically significant correlation between high grade injury (grade 4/5) with both active extravasation ( $p = 0.002$ ) and collecting system stenting ( $p < 0.001$ ). Finally, there was no statistically significant correlation between high vs low grade of injury with surgical or endovascular management ( $p = 0.07$ ).

## CONCLUSION

Active extravasation is a significant predictor of surgical or endovascular management of renal trauma. The AAST grade does not correlate with the need for surgical or endovascular management, however, it does correlate with collecting system injury and intervention.

## CLINICAL RELEVANCE/APPLICATION

An imaging based renal trauma scoring system that incorporates active extravasation may be necessary to more accurately predict patient outcomes.

## Honored Educators

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Jorge A. Soto, MD - 2013 Honored Educator

Jorge A. Soto, MD - 2014 Honored Educator

Jorge A. Soto, MD - 2015 Honored Educator

## RC608-07 Question and Answer

Thursday, Dec. 3 10:00AM - 10:15AM Location: S405AB

Participants

## RC608-08 Imaging of Thoracic Trauma

Thursday, Dec. 3 10:15AM - 10:40AM Location: S405AB

Participants

Constantine A. Raptis, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1) Review key imaging findings which need to be identified on the trauma chest radiograph. 2) Discuss indications for thoracic CT imaging in trauma patients. 3) Introduce an organized approach to the chest CT in thoracic trauma. 4) Identify and understand important findings which are commonly seen on chest CT examinations in trauma.

## ABSTRACT

### RC608-09 'Time to Revisit Major Trauma Imaging Approach?': Lung Ultrasound-FAST (LUS-FAST) Plus WB-MDCT in Pneumothorax Diagnosis

Thursday, Dec. 3 10:40AM - 10:50AM Location: S405AB

Participants

Stefania Ianniello, Roma, Italy (*Presenter*) Nothing to Disclose

Michele Galluzzo, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

Barbara Sessa, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

Claudio Ajmone Cat, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

Giuseppe Nardi, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

Vittorio Miele, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

In Major Trauma (ISS - Injury Severity Score  $\geq 15$ ), imaging approach of A.T.L.S. take into account supine- CXR for pneumothorax detection, during Primary Survey that have shown low accuracy in the assessment of pneumothorax while it's clearly demonstrated the superiority of lung ultrasound for this diagnosis. The aim of our study was to evaluate the clinical impact for pneumothorax diagnosis of new Imaging approach in a Trauma dedicated logistical context (Shock Room, CT Room, Operating Room strictly closed; Emergency Radiologist 24h/7days): only extended (to thorax)-focused assessment with sonography in trauma (e-FAST), during Primary Survey, and Whole-Body Multidetector Computed Tomography (MDCT) as secondary, during two years of experience in our Level I Trauma Center.

## METHOD AND MATERIALS

This was a retrospective case-series study involving 660 consecutive adult patients admitted to the our Emergency Department (422 men and 238 women) (average age: 41y- age range: 18-81y) between January 2013-December 2014 for a Major Trauma. We evaluated the accuracy of lung ultrasonography in the detection of pneumothorax (compared with the results of Multidetector Computed Tomography (MDCT) and of invasive interventions (thoracostomy tube placement), and timing of this imaging approach.

## RESULTS

Among the 1320 lung fields included in the study, we observed 264 pneumothoraces with thoracic MDCT scans. The e-FAST detected 242 pneumothoraces and didn't recognize 22 pneumothoraces. About 2 years, total diagnostic performance of L.US was: sensitivity 92%, specificity 100%, PPV 100%, NPV 98%, Accuracy 98%. At Major Trauma's arrival, median time to achieve pneumothorax diagnosis with Extended was 3 min. (1-5'). These results demonstrate that (e-FAST + WB-MDCT) has good results, reduces time (e-FAST within 5'; WB-MDCT within 40') and effectively omits many diagnostic steps between clinical suspicion and definitive proof of injuries that require immediate therapeutic attention. Beyond pneumothorax diagnosis, further studies will occur to analyze clinical impact for every single others traumatic lesions.

## CONCLUSION

This new Imaging approach, Lung Ultrasound-FAST during primary survey, and WB-MDCT as secondary, demonstrate high accuracy to achieve avoidable pneumothorax's death; CT scanner should be placed very close to, or in the trauma room; Emergency Radiologist available 24h/7d.

## CLINICAL RELEVANCE/APPLICATION

A new powerful Ultrasound field: pneumothorax diagnosis.

### RC608-10 Value of Contrast Enhanced CT in Detecting Blunt Traumatic Injury of the Diaphragm: Retrospective Review

Thursday, Dec. 3 10:50AM - 11:00AM Location: S405AB

#### Participants

Daniel Lamus, MD, San Antonio, TX (*Presenter*) Nothing to Disclose  
Carlos S. Restrepo, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose  
Brian Eastridge, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose  
Abdul Alarhayem, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Retrospectively review the accuracy of MDCT for the detection of acute blunt traumatic injury of the diaphragm. Identify the most relevant imaging signs of diaphragmatic injury.

## METHOD AND MATERIALS

A waiver for informed consent was granted by the institutional review board. We retrospectively reviewed the records of all patients admitted to our Level I trauma center with intraoperative findings of diaphragmatic injury between 2005 and 2015. Our study was limited to the patients with blunt trauma and a total of 57 patients met this criteria. A group of 10 patients were excluded from the analysis, since diagnosis was made with the initial AP chest radiograph or with the scout view and therefore underwent corrective surgery before being scanned. An additional patient was excluded given that imaging studies were not available.

## RESULTS

The diagnosis of diaphragmatic injury was confirmed by using the intraoperative findings as the reference standard. Review of the official radiologic interpretation at the time of admission, yielded a sensitivity of 71% ( $p < 0.005$ ). A secondary assessment of the available images was also conducted, including a systematic evaluation for the presence of alternative signs of diaphragmatic injury that have been previously described by others. This approach resulted in an increased sensitivity of 93% ( $p < 0.005$ ). Multivariate analysis including laterality of the injury was also included to complement the statistical analysis.

## CONCLUSION

To our knowledge this is the largest series of blunt diaphragmatic injury in the English literature. Left sided injuries are more evident and usually present as herniation while diaphragmatic thickening/hematoma was highly specific of right sided injuries. MDCT is a useful tool in the detection of blunt diaphragmatic injuries; the use of a systematic approach may increase its accuracy.

## CLINICAL RELEVANCE/APPLICATION

The widespread use of MDCT in the evaluation of patients with major trauma has improved the detection and characterization of injuries to most organs and structures. In spite of the technologic advances, the detection of diaphragmatic injury remains a diagnostic challenge in the setting of acute trauma. Ischemia to the bowel and other structures has been described as early as 24 hours after the initial injury, hence in the era of nonoperative management of abdominal trauma, timely diagnosis and operative repair of diaphragmatic injury is crucial to avoid complications.

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Carlos S. Restrepo, MD - 2012 Honored Educator  
Carlos S. Restrepo, MD - 2014 Honored Educator

### RC608-11 Hepatic Injuries

Thursday, Dec. 3 11:00AM - 11:25AM Location: S405AB

#### Participants

Kathirkamanathan Shanmuganathan, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1) Demonstrate the spectrum of traumatic liver injury. 2) Discuss the performance and utility of late arterial and portal venous phase images. 3) Discuss the relevance of the various CT findings to management.

### RC608-12 Blunt Bowel and Mesenteric Injury: Can We Grade It? Yes We Can!

Thursday, Dec. 3 11:25AM - 11:35AM Location: S405AB

#### Participants

Andres R. Ayoob, MD, Lexington, KY (*Abstract Co-Author*) Nothing to Disclose  
James T. Lee, MD, Lexington, KY (*Presenter*) Nothing to Disclose

Gustav A. Blomquist, MD, Lexington, KY (*Abstract Co-Author*) Nothing to Disclose  
David J. Nickels, MD, Lexington, KY (*Abstract Co-Author*) Nothing to Disclose  
Phillip Chang, MD, Lexington, KY (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

CT grading of traumatic solid organ injuries is well established. A grading scale based on CT findings for blunt bowel or mesenteric injuries does not exist [2,3]. With the advent of high speed, multi-detector CT we hypothesize that blunt bowel and mesenteric injuries requiring operative intervention can be graded by CT imaging.

## METHOD AND MATERIALS

IRB approved, retrospective review of our level-I ACS verified trauma center database of patients with blunt trauma that had both a multi-detector CT scan and laparotomy from 1/2010 to 9/2011 were included. A single trauma surgeon reviewed operative reports and determined the primary outcome of bowel/mesenteric injury requiring surgical intervention (IRSI). The first 20 patients with IRSI were randomly matched to 20 patients during the same study period without IRSI. 3 emergency radiology attendings were blinded and reviewed all 40 subjects. They scored based on the scoring system developed internally. After initial individual reading session, a consensus reading session was performed on discrepant scoring. Receiver operating characteristic (ROC) curves and sensitivity/specificity analyses were performed on the scores relative to IRSI.

## RESULTS

The 2 groups were matched by age, sex, injury severity score (ISS), and timing of presentation to scan and eventual operation (standardized differences < .10). No individual radiologist's scores reached both sensitivity and specificity  $\geq 75\%$  relative to IRSI. AUROCs showed "good" (>.6) to "very good" (>.8) discrimination of IRSI. The consensus score AUROC of .799 is good, with .800 considered very good discrimination of the need for surgical intervention (Figure 1). The consensus score of all three radiologists of a  $\geq$  Grade 3 injury was sensitive (75%) and specific at (79%) for the need for surgical intervention. Risk for surgical intervention increased linearly with consensus score. ( $R^2 = .965$ ) (Figure 2).

## CONCLUSION

The proposed grading system demonstrates proof of concept in becoming a diagnostic tool in the management of blunt bowel and mesenteric IRSI injuries. The scale provides significant information regarding the extent of injury, need for surgery with diagnostic significance in the very first iteration of this application. Further studies are needed to validate the grading scale.

## CLINICAL RELEVANCE/APPLICATION

CT grading scale for bowel and mesenteric injury is possible and may improve communication between radiologist and surgeon.

## RC608-13 Inter-reader Agreement in the Detection and Classification of Pancreatic Trauma Injury on CT Using AAST Pancreatic Injury Scoring System

Thursday, Dec. 3 11:35AM - 11:45AM Location: S405AB

### Participants

Marta E. Heilbrun, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose  
Nickolas Byrge, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose  
Daniel N. Sommers, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose  
Nicole S. Winkler, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose  
Raminder Nirula, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Pancreatic injuries occur in 1-5% of blunt and penetrating trauma. Mortality may be as high as 20%, often relates to the presence of other injuries, and increases with delayed diagnosis. The sensitivity of CT ranges from 65-91%. Up to 40% of patients may show no abnormality of the pancreas on initial CT and extent of injury may be difficult to characterize. Assessment of pancreatic duct integrity is critical since disruption causes most complications. The 5-point American Association for the Surgery of Trauma (AAST) pancreas injury scale is an accepted scoring system. Intervention may be necessary if AAST  $\geq 3$ . The goal of this study is to determine if there is reader agreement on the presence of pancreatic injury and the extent of injury based on AAST scores on initial trauma CT.

## METHOD AND MATERIALS

102 CTs from an multi-institutional AAST de-identified trauma database were reviewed by 3 fellowship trained abdominal radiologists after an initial training. Training was completed after agreement  $>0.6$  (25 studies). Blinded to clinical information and each other, the readers assigned a binary score (Y/N) to the presence of pancreatic injury, pancreatic duct injury, a 4 point Likert item scale for confidence in injury scores and AAST score. Interrater reliability is assessed with the intraclass correlation coefficient.

## RESULTS

The binary assessment of any pancreatic injury ranged from 80-93% for the 3 readers, with interrater agreement of 0.37(95%CI,0.25-0.50) and confidence of assessment 0.53(95%CI,0.40-0.64). The binary assessment of any ductal injury ranged from 31-39% with interrater agreement of 0.65(95%CI,0.52-0.75) and confidence of 0.70(95%CI,0.60-0.78). Mean AAST score ranged from 1.8-2.4. Interrater agreement for AAST score is 0.69(95%CI,0.58-0.77). The greatest disagreement related to the absence of any pancreatic injury, with 2 readers giving 21 studies no injury, but 1 reader giving 7 studies no injury.

## CONCLUSION

Even with training, there was relatively poor agreement when there is no or minimal pancreas injury. There is better agreement when there is more extensive injury, especially suspected duct injury. Readers demonstrate good agreement when using the AAST injury score.

## CLINICAL RELEVANCE/APPLICATION

Clinically actionable pancreatic trauma (ductal injury) is reliably recognizable on CT. The use of surgical scoring systems, such as the AAST pancreatic injury score, improves reader agreement.



**RC608-14 Question and Answer**

Thursday, Dec. 3 11:45AM - 12:00PM Location: S405AB

Participants

MSES51

## Essentials of Non-interpretative Skills

Thursday, Dec. 3 8:30AM - 10:00AM Location: S406B



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

### Participants

### Sub-Events

#### MSES51A How a Dictation Becomes a Dollar

### Participants

Ezequiel Silva III, MD, San Antonio, TX, (zekesilva3@gmail.com) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Gain an understanding of each step in the payment process including diagnosis and procedural coding, as well as valuation. 2) Apply these concepts to future alternative payment models. 3) Explore financial performance indicators for billing entities and how these indicators are used to evaluate our internal and external billing processes. 4) Discuss questions which these concepts should prompt when pursuing new practice opportunities.

### ABSTRACT

The ability to navigate future payment models will require basic knowledge of the manner in which radiology services are paid within current systems. This session will take the participant through every step in the payment process and focus on how each element of the interpretive dictation impacts the payment process. Focus will be given to diagnosis and procedural coding and how that translates to medical necessity and eventual valuation. An introduction to alternative payment models will follow and the session will close with a glimpse at financial performance indicators every radiologists should understand.

### Handout:Ezequiel Silva

[http://abstract.rsna.org/uploads/2015/15001830/Dictation to Dollar notes.docx](http://abstract.rsna.org/uploads/2015/15001830/Dictation%20to%20Dollar%20notes.docx)

#### MSES51B Radiologist Value Based Payments: Myth or Reality?

### Participants

Giles W. Boland, MD, Boston, MA (*Presenter*) Principal, Radiology Consulting Group; Royalties, Reed Elsevier

### LEARNING OBJECTIVES

1) To understand the changing payment landscape and how it could impact radiology revenue streams. Quality, safety and patient experience factors will likely factor into value based payments. This section will focus on the impending transformation that will be likely occur and what strategies radiologists can employ to take advantage.

### ABSTRACT

#### MSES51C Fundamentals of CT Data Acquisition

### Participants

Sandra S. Halliburton, PhD, Highland Heights, OH, (sandra.halliburton@philips.com) (*Presenter*) Employee, Koninklijke Philips NV

### LEARNING OBJECTIVES

1) Identify the basic hardware components of a CT scanner. 2) Understand the standard methods for acquiring CT data. 3) Describe important user-defined parameters for data acquisition. 4) Select appropriate data acquisition parameters based on patient characteristics and clinical indication.

#### MSES51D Radiology Malpractice: Pitfalls to Avoid

### Participants

Richard Duszak JR, MD, Atlanta, GA, (richard.duszak@emory.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Articulate the four criteria necessary for a successful malpractice lawsuit. 2) Outline factors contributing to a "missed" imaging diagnosis. 3) Describe opportunities to enhance communication with referring physicians and patients so as to improve care and minimize malpractice exposure.

RC653

## Managing Radiology IT in the EHR World

Thursday, Dec. 3 8:30AM - 10:00AM Location: S502AB



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

### Participants

J. R. Geis, MD, Fort Collins, CO (*Moderator*) Advisor, Nuance Communications, Inc; Investor, Montage Healthcare Solutions; Vice Chair, ACR IT Informatics Commission

### LEARNING OBJECTIVES

1) Identify EHR components relevant to radiology. 2) Understand how to assess and use those components to your advantage. 3) Discover potential and pitfalls of EHRs.

### ABSTRACT

#### Sub-Events

#### RC653A EHR/RIS Optimization of Imaging Workflow for the Enterprise

#### Participants

Peter B. Sachs, MD, Aurora, CO (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Review the typical radiology department work flow in an EMR environment. 2) Identify the key work flow items that may require optimization. 3) Identify the key components necessary to carry out optimization. 4) Review examples of optimizations carried out at the author's institution. 5) Discuss the impact these optimizations have had on radiology workflow/efficiency and patient care.

### ABSTRACT

The development and deployment of electronic medical records has resulted in a significant impact on radiology work flow both positive and negative. Moving from paper driven to an electronic processes requires a highly functional, multi-disciplinary team to address break-fixes as well as optimizations. This presentation will review the optimal structure of the team and then discuss the requisite skill sets of the team members to insure getting the most out of the EHR to drive high quality, efficient, patient-centered work flow in the radiology department.

#### RC653B RIS-EMR Driven Workflow for Diagnostic Radiologists - You Might Actually Want This

#### Participants

Cree M. Gaskin, MD, Keswick, VA (*Presenter*) Author with royalties, Oxford University Press; Author with royalties, Thieme Medical Publishers, Inc; ;

### LEARNING OBJECTIVES

1) Present EHR driven workflow for the diagnostic radiologist at the speaker's institution. 2) Discuss radiologist engagement in EHR implementation for radiology-centric optimization. 3) Discuss impacts of EHR driven workflow on diagnostic radiologists' efficiency and quality of care delivery as well as user satisfaction.

### ABSTRACT

Electronic Health Records (EHRs) are touted to improve the quality and efficiency of clinical care. As a result, EHR-meaningful use legislation has been passed in the U.S. to financially incentivize adoption of this technology. Still, some radiologists remain skeptical that the benefits of EHRs are applicable to their practice and some fear that the technology could even unnecessarily complicate their workflow. One newer model for integrating EHRs into radiologists' practice is to use an EHR to drive diagnostic radiologist workflow, rather than the more traditional or widespread models of PACS driven or third-party RIS driven workflow. This newer model provides opportunity to leverage EHR technology and data for the benefit of radiology-related care delivery. This presentation shares a radiologist-centric viewpoint from one institution which has successfully adopted EHR-driven workflow for diagnostic radiologists. Though the process of implementation is touched upon, the presentation focuses on the resultant clinical workflow and the impacts on quality, efficiency, and radiologist satisfaction.

#### RC653C PACS and Radiologist Workflow in a Multi-Enterprise Environment

#### Participants

Gary J. Wendt, MD, MBA, Middleton, WI (*Presenter*) Medical Advisory Board, McKesson Corporation; Medical Advisory Board, HealthMyne; Owner, WITS(MD), LLC; ;

### LEARNING OBJECTIVES

1) Understand workflow challenges for a radiologist operating a multi-enterprise environment. 2) Understanding requirements for environments with a single versus multiple medical record numbers a. PACS b. Dictation systems c. EHR. 3) Using a master patient index to link patient's across sites.

### ABSTRACT

As a radiology department expands across multiple organizations there are several challenges that are created. Among these is the capability of the PACS, dictation systems and electronic medical record to operate in a single versus a multiple medical record

number environment. These challenges are complicated further if there is no master patient index to link patient's across the multiple sites. All of these need to be taken into consideration prior to attempting to deploy a single workflow solution in multiple environments. Some possibilities that are discussed include using systems that function in a multiple medical record number environment, making changes to the demographic information in an interface engine or simply guaranteeing that each site uses unique identifiers. The benefits of having a single workflow solution across multiple environments is significant and helps to justify the cost of implementing in maintaining this type of environment.

**Tweet This: How to Make Radiology More Patient Centered (Sponsored by the RSNA Public Information Committee)**

Thursday, Dec. 3 8:30AM - 10:00AM Location: S403A

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

Judy Yee, MD, San Francisco, CA, (judy.yee@ucsf.edu) (*Moderator*) Research Grant, EchoPixel, Inc  
Whitney Fishman Zember, MBA, New York, NY (*Presenter*) Nothing to Disclose  
Susan D. John, MD, Houston, TX (*Presenter*) Nothing to Disclose  
Elliot K. Fishman, MD, Owings Mills, MD (*Presenter*) Research support, Siemens AG Advisory Board, Siemens AG Research support, General Electric Company Advisory Board, General Electric Company Co-founder, HipGraphics, Inc

**LEARNING OBJECTIVES**

1) Understand the rationale for and growing value of increased personalization of patient interactions in diagnostic radiology. 2) Communicate patient-centered radiology principles to residents and other colleagues. 3) Identify different avenues, including traditional, digital and social media, to engage our patients.

**ABSTRACT**

Modern medicine has become so complicated and sub-specialized that patients and their families often are confused. Frequently patients are not even aware that a radiologist is providing important services or the nature of those services. Increasingly, patients are turning to the Internet for answers. In the current era of consumer-driven healthcare, patient portals, online health resources and social media, radiologists must provide personal and patient-friendly services and use a variety of means to connect with patients. This course will provide specific examples and strategies for harnessing the power of the Internet and social media to become more patient centered.

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Elliot K. Fishman, MD - 2012 Honored Educator  
Elliot K. Fishman, MD - 2014 Honored Educator

**Quantitative Imaging and Informatics (In Association with the Society for Imaging Informatics in Medicine)**

Thursday, Dec. 3 8:30AM - 10:00AM Location: S501ABC



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

**Participants**

Adam E. Flanders, MD, Penn Valley, PA, (adam.flanders@jefferson.edu) (*Moderator*) Nothing to Disclose

Luciano M. Prevedello, MD, MPH, Columbus, OH (*Moderator*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Develop an understanding of what quantitative imaging is and how it may revolutionize the way we practice diagnostic radiology today. 2) Learn the research advances and the current clinical applications of this technology. 3) Appreciate the current challenges involved in using these tools clinically and understand the steps required for a successful clinical implementation.

**ABSTRACT**

Medicine has undergone a gradual evolution in which diagnostic imaging has become the centerpiece in establishing a clinical diagnosis and in assessing disease response. In recent years, the focus has changed such that for some disease categories (e.g. oncology) we now perceive medical imaging as a phenotypic expression of the genetic makeup of that disease. To that end, imaging now serves as a biomarker of genetic disease subtypes with features that may offer clues to understanding the natural behavior of the disease and specific changes that may occur as part of a therapeutic response. It is now well recognized that there is a substantial amount of objective information contained within diagnostic imaging studies that can be exploited beyond the level of simple measurements. The extraction of quantitative and semi-quantitative information from imaging studies that is both useful and reproducible is the challenge and opportunity for clinical trials research and radiologic reporting today and in the future. This session will explore the revolution and evolution of quantitative imaging; providing attendees with research advances, clinical applications, and the challenges of clinical implementation.

**Sub-Events****RCC51A What is Quantitative Imaging?****Participants**

Katherine P. Andriole, PhD, Dedham, MA (*Presenter*) Advisory Board, McKinsey & Company, Inc;

**LEARNING OBJECTIVES**

1) Be able to describe what is meant by quantitative imaging. 2) Understand existing issues in implementing quantitative imaging techniques in the clinical arena as well as in the research realm, and see how informatics tools may help. 3) Be aware of on-going international efforts to address current challenges and to move quantitative imaging forward.

**ABSTRACT**

Quantitative imaging has rapidly evolved in recent years from a promising research activity to an essential clinical tool. Physicians consider the objective metrics obtained from imaging studies, in making critical patient management decisions. What is meant by quantitative imaging will be described using illustrative real-world use cases. Existing issues including technical as well as workflow challenges will be discussed. An introduction to imaging informatics tools and techniques such as standards, integration, data mining, cloud computing, ontologies, data visualization and navigation tools, and business analytics applications that may assist in filling current gaps in the clinical implementation of quantitative imaging will be given. An overview of activities of the RSNA's Quantitative Imaging Biomarkers Alliance (QIBA), an international initiative whose goal is to optimize the potential of quantitative imaging, including a description of the data warehouse project will be provided.

**RCC51B Informatics Approaches to Enable Quantitative Imaging in Real World Radiology Practice****Participants**

Daniel L. Rubin, MD, MS, Palo Alto, CA (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To highlight limitations in current radiological quantitative imaging practice and identify opportunities for improvement through informatics. 2) To introduce Annotation and Image Markup (AIM) as a new standard for capturing and sharing quantitative imaging metadata. 3) To demonstrate new AIM-enhanced tools that can streamline and improve quantitative imaging assessment and workflow for the radiologist.

**ABSTRACT**

Radiology practice is increasingly a quantitative endeavor. Radiologists frequently need to measure the length of lesions to track treatment response or measure the size of structures to for diagnostic assessment. Current practices of quantitation are cumbersome; measurements are recorded as screen captures that cannot be processed by machine, and the numbers must be transcribed into a radiology report. It is currently exceedingly difficult to create structured databases of quantitative image information for discovery about how, say, change in tumor size over time relates to drug treatment. Quantitative imaging is currently at best a labor-intensive process and at worst error-prone. We have been developing informatics methods to streamline the electronic capture of quantitative imaging results as "image metadata" in structured format that can be easily processed by computers. Tools that we are producing will allow the radiologist to perform quantitative imaging assessment in their current routine workflow-measuring lesions on the PACS, while simultaneously their measurements will be captured and transmitted in standardized formats to applications that can automate accurate reporting, analysis, and decision support. In the future such tools will even help researchers to discover new ways that quantitative signals in images can improve assessment of treatment and prediction of

disease course.

#### **Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Daniel L. Rubin, MD, MS - 2012 Honored Educator

Daniel L. Rubin, MD, MS - 2013 Honored Educator

#### **RCC51C QI Clinical Use Cases Outside of Oncology**

##### **Participants**

Eliot L. Siegel, MD, Severna Park, MD (*Presenter*) Research Grant, General Electric Company; Speakers Bureau, Siemens AG; Board of Directors, Carestream Health, Inc; Research Grant, XYBIX Systems, Inc; Research Grant, Steelcase, Inc; Research Grant, Anthro Corp; Research Grant, RedRick Technologies Inc; Research Grant, Evolved Technologies Corporation; Research Grant, Barco nv; Research Grant, Intel Corporation; Research Grant, Dell Inc; Research Grant, Herman Miller, Inc; Research Grant, Virtual Radiology; Research Grant, Anatomical Travelogue, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, Toshiba Corporation; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Bayer AG; Research, TeraRecon, Inc ; Medical Advisory Board, Bracco Group; Researcher, Bracco Group; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Researcher, Microsoft Corporation

##### **LEARNING OBJECTIVES**

1) List the current greatest challenges to quantitative imaging from an informatics perspective. 2) Describe how data from clinical trials and the electronic medical record can provide decision support tools associated with the application of quantitative imaging. 3) Be able to articulate the requirements for 'next generation' quantitative imaging and opportunities for improvement of the current generation of CAD software.

##### **ABSTRACT**

In the current and future era of Big Data and advanced algorithms to model and diagnose complex disease, structured reporting, natural language processing and quantitative imaging have become essential elements for diagnostic imaging. Additionally it is absolutely essential that our imaging reports including scanning parameters, diagnosis, findings, recommendations, etc. as well as quantitative measurements and impressions from the pixel data be made available for the next generation of diagnostic, staging, and treatment algorithms. Currently there are several major challenges to making these imaging data accessible in a machine recognizable manner and these will be listed, including the application of a method to 'tag' medical images and a means of structuring and classifying findings made by radiologists and other human interpreters as well as computer algorithms that make quantitative measurements and computer aided detection and diagnosis. Once these data are available they can be utilized for decision support in radiology such as determination of which patients should be screened, estimation of the likelihood of malignancy when a nodule is detected, and refinement of CAD algorithms based on a priori estimates of likelihood of disease.

RC622

## Personalized Medicine: Thorax

Thursday, Dec. 3 8:30AM - 10:00AM Location: S504AB

CH RO PH

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

### Participants

Kristy K. Brock, PhD, Ann Arbor, MI (*Moderator*) License agreement, RaySearch Laboratories AB;

### Sub-Events

#### RC622A Personalized Medicine: Thorax - Motion and IGRT

### Participants

Geoffrey Hugo, PhD, Richmond, VA, (gdhugo@vcu.edu) (*Presenter*) Research Grant, Koninklijke Philips NV; Research Grant, Varian Medical Systems, Inc

### LEARNING OBJECTIVES

- 1) Understand how respiration impacts radiotherapy imaging and delivery and how to implement strategies to mitigate these issues.
- 2) Understand types and magnitude of geometric changes in thoracic anatomy during radiotherapy, and determine approaches to correct for discrepancies between the planned and delivered dose to the patient.

### ABSTRACT

Radiotherapy is in widespread use for both early and advanced stage lung cancer, as a sole modality and also in combination with other modalities such as chemotherapy. Due to the potential for both acute and late toxicities in organs adjacent to treated regions, modern techniques seek to limit the extent of the high dose volume. The purpose of this session is to develop an understanding for how geometric and anatomic changes during radiotherapy can be managed. The focus will be on solutions readily available in the clinic today, particularly with respect to imaging modalities and planning solutions.

#### RC622B Functional Targeting and Adaptation

### Participants

Martha M. Matuszak, PhD, Ann Arbor, MI (*Presenter*) Research Grant, Varian Medical Systems, Inc

### LEARNING OBJECTIVES

- 1) Understand the opportunities for targeting and avoidance based on functional imaging in lung.
- 2) Discuss the technical details of functional targeting for tumor and functional avoidance in normal tissue for lung cancer in the pre-treatment and adaptive settings.

### ABSTRACT

Radiation therapy continues to play an important role in the treatment of lung cancer although many opportunities remain to improve local control and survival as well as reduce toxicity, especially in advanced stage lung cancer. The use of functional imaging and biomarkers to predict tumor burden and response as well as measure and predict normal tissue toxicity has begun to increase in the community. This session aims to summarize the different modalities and types of information available to perform functional targeting or avoidance of tumor and normal tissue in lung cancer, including imaging (such as PET and SPECT) and other data (such as blood-based biomarkers). The session will also highlight the technical details associated with the use of functional data for treatment planning, treatment response, and adaptation.



RC617

## MR Neurography and New Methods to Image Pain

Thursday, Dec. 3 8:30AM - 10:00AM Location: S505AB



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

### Participants

Sandip Biswal, MD, Stanford, CA (*Moderator*) Co-founder, SiteOne Therapeutics Inc; Research Grant, General Electric Company; Stockholder, Atreus Pharmaceuticals Corporation

### Sub-Events

#### RC617A MR Neurography of the Brachial Plexus and Upper Extremities

### Participants

Amelie M. Lutz, MD, Stanford, CA (*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.

#### RC617B MR Neurography of the Lumbar Plexus and Lower Extremities

### Participants

Avneesh Chhabra, MD, Dallas, TX, (avneesh.chhabra@utsouthwestern.edu) (*Presenter*) Research Consultant, Siemens AG; Consultant, ICON plc

### LEARNING OBJECTIVES

1) Employ new techniques for LS plexus and lower extremity evaluation. 2) Understand the differences 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.

#### RC617C DTI of the Peripheral Nervous System

### Participants

Gustav Andreisek, MD, Zurich, Switzerland (*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 time 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 extent 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.

#### **RC617D      PET and MR Methods to Image Pain**

##### **Participants**

Sandip Biswal, MD, Stanford, CA (*Presenter*) Co-founder, SiteOne Therapeutics Inc; Research Grant, 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 of 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.

MSCN51

## Case-based Review of Neuroradiology (An Interactive Session)

Thursday, Dec. 3 8:30AM - 10:00AM Location: S100AB

HN NR

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

### Participants

Pina C. Sanelli, MD, Manhasset, NY (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Improve basic knowledge and skills relevant to clinical practice. 2) Practice formulating a differential diagnosis for pathologic diseases involving the brain, spine, head and neck. 3) Apply principles of critical thinking to challenging diagnostic imaging cases.

### ABSTRACT

The learning objectives are to enable attendees to: 1. Improve basic knowledge and skills relevant to clinical practice. 2. Practice formulating a differential diagnosis for pathologic diseases involving the brain, spine, head and neck. 3. Apply principles of critical thinking to challenging diagnostic imaging cases.

### Sub-Events

#### MSCN51A Adult Brain

### Participants

Pamela W. Schaefer, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Recognize the key neuroimaging characteristics of various adult cerebral disease entities. 2) Use pertinent imaging features and key clinical factors to formulate a pertinent differential diagnosis for various adult cerebral pathologies. 3) Discuss the utility of various imaging techniques for evaluating various adult cerebral disorders. 4) Review pertinent anatomy as it pertains to common adult cerebral pathologies.

#### MSCN51B Adult Spine

### Participants

Gordon K. Sze, MD, New Haven, CT (*Presenter*) Investigator, Remedy Pharmaceuticals, Inc

### LEARNING OBJECTIVES

1) To analyze findings on imaging examinations of the spine. 2) To characterize unusual findings and provide a differential diagnosis.

### ABSTRACT

Lesions of the spine and of the spinal cord can be divided into broad categories. Use of an organized approach to the analysis of difficult cases will allow one to refine a differential diagnosis. Cord lesions, in particular, often superficially resemble one another. By exploring and applying the broad categories of diseases that affect the cord, subtle differences can be brought out.

#### MSCN51C Adult Head and Neck

### Participants

Hugh D. Curtin, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To use imaging findings to differentiate head and neck lesions that can occur in similar locations. 2) To identify and evaluate imaging landmarks that determine changes in treatment.

RC650

## Vertebral Augmentation (Hands-on)

Thursday, Dec. 3 8:30AM - 10:00AM Location: E260



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

### Participants

A. Orlando Ortiz, MD, MBA, Mineola, NY (*Presenter*) Nothing to Disclose  
Bassem A. Georgy, MD, MSc, San Diego, CA (*Presenter*) Consultant, Johnson & Johnson; Consultant, DFINE, Inc; Stockholder, DFINE, Inc ; Stockholder, Spine Solutions, Inc ; ;  
Allan L. Brook, MD, Bronx, NY (*Presenter*) Advisor, Johnson & Johnson Advisor, Medtronic, Inc  
Afshin Gangi, MD, PhD, Strasbourg, France (*Presenter*) Nothing to Disclose  
Todd S. Miller, MD, Bronx, NY, (Tmiller@montefiore.org) (*Presenter*) Nothing to Disclose

### 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 imaging guidance, These procedures have been shown to provide pain relief by stabilizing the fractured vertebra 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

#### Handout: Afshin Gangi

[http://abstract.rsna.org/uploads/2015/4426453/Vertebral augm tumor.pptx](http://abstract.rsna.org/uploads/2015/4426453/Vertebral%20augm%20tumor.pptx)

#### Active Handout: Todd Stuart Miller

[http://abstract.rsna.org/uploads/2015/4426453/RC650 Vertebroplasty MILLER.pptx.pdf](http://abstract.rsna.org/uploads/2015/4426453/RC650%20Vertebroplasty%20MILLER.pptx.pdf)

## Techniques for Interventional Sonography and Thermal Ablation (Hands-on)

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



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

### Participants

Patrick Warren, MD, Columbus, OH (*Moderator*) Nothing to Disclose  
 Veronica J. Rooks, MD, Honolulu, HI (*Presenter*) Nothing to Disclose  
 Corrie M. Yablon, MD, Ann Arbor, MI, (cyablon@med.umich.edu) (*Presenter*) Nothing to Disclose  
 Andrada R. Popescu, MD, Chicago, IL (*Presenter*) Nothing to Disclose  
 Linda J. Warren, MD, Vancouver, BC (*Presenter*) Shareholder, Hologic, Inc  
 Hisham A. Tchelepi, MD, Los Angeles, CA (*Presenter*) Research Grant, General Electric Company; Research Grant, Roper Industries, Inc  
 John M. Racadio, MD, Cincinnati, OH (*Presenter*) Research Consultant, Koninklijke Philips NV; Travel support, Koninklijke Philips NV  
 Mahesh M. Thapa, MD, Seattle, WA (*Presenter*) Nothing to Disclose  
 Kristin M. Dittmar, MD, Columbus, OH (*Presenter*) Nothing to Disclose  
 Adam S. Young, MD, MBA, Boston, MA (*Presenter*) Nothing to Disclose  
 Stephen C. O'Connor, MD, Springfield, MA (*Presenter*) Nothing to Disclose  
 Kal Dulaimy, MD, Springfield, MA (*Presenter*) Nothing to Disclose  
 Christian L. Carlson, MD, MS, Cibola, TX (*Presenter*) Nothing to Disclose  
 Andrew J. Rabe, DO, Columbus, OH (*Presenter*) Nothing to Disclose  
 Jeremiah J. Sabado, MD, Columbus, OH (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify basic skills, techniques, and pitfalls of freehand invasive sonography. 2) Discuss and perform basic skills involved in thermal tumor ablation in a live learning model. 3) Perform specific US-guided procedures to include core biopsy, abscess drainage, vascular access, cyst aspiration, soft tissue foreign body removal, and radiofrequency tumor ablation. 4) Incorporate these component skill sets into further life-long learning for expansion of competency and preparation for more advanced interventional sonographic learning opportunities.

### ABSTRACT

Ultrasound Guided Foreign Body Removal: Simulation Training and Clinical implementation Outcomes ; Purpose: USFBR can be taught to radiologists to generate competency, and radiologists can apply the technique in the patient setting to remove foreign bodies. ; Materials and Methods: Proof of concept was performed by a radiologist and surgeon removing nine 1-cm foreign bodies using the USFBR method (P) and traditional surgery (S) with and without wire guidance (W) on the cadaver model. ; Next, USFBR was taught to 48 radiologists at 4 hospitals. Training included didactic and hands-on instruction covering 7 components: instrument alignment, hand/transducer position, forceps use, foreign body definition, forceps grasp, recognition of volume averaging, and oblique cross cut artifact. Pre-training testing assessed single toothpick removal from turkey breast in 15 minutes.; Post-training evaluation consisted of 5 toothpick removals. ; Ongoing clinical implementation data of USFBR by trained radiologists are being collected. Parameters including age of patient, which radiologist, removal success, type and size of foreign body, incision size, foreign body retention time, reason for removal, symptoms, modalities used in detection, wound closure, and sedation are recorded. Data analyzed using chi-squared and Fisher's exact tests for categorical outcomes and analysis of variance for continuous outcomes. ; Results: USFBR technique shows a higher success rate and smaller incision size in comparison to surgical technique alone in the cadaver. Removal success: P 100%, S 78%, and W 89%. ; With USFBR training, radiologists' scores improved from 21-52% pre-training to 90-100% post-training (p;0.001 for each component). In the clinical setting to date, USFBR has been 100% successful in 7 (of 25 expected) patients, ages 9-73 years, by four radiologists. Parameters included; length 4 to 30 mm, retention 2 to 864 days, incision, 2 to 8 mm. 1 suture closure. 1 sedation. ;

RC651

## Pediatric Series: Optimizing Acquisition and Achieving Efficiency in Pediatric Imaging

Thursday, Dec. 3 8:30AM - 12:00PM Location: S102D

MR PD SQ

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

FDA Discussions may include off-label uses.

### Participants

Donald P. Frush, MD, Durham, NC (*Moderator*) Nothing to Disclose  
Aliya Qayyum, MBBS, Houston, TX (*Moderator*) Nothing to Disclose  
Rajesh Krishnamurthy, MD, Houston, TX (*Moderator*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation  
A. James Barkovich, MD, San Francisco, CA (*Moderator*) Nothing to Disclose

### LEARNING OBJECTIVES

#### ABSTRACT

This session will focus on the importance of minimizing general endotracheal anesthesia in children and discuss recent papers that highlights risks in children. It will discuss techniques for minimizing the use of sedation and intubation in pediatric imaging, including use of abbreviated protocols for common indications, feed and wrap techniques, and state of the art MR sequences for free-breathing 2-D and 3-D acquisition of morphology, function and flow in children.

#### Sub-Events

#### RC651-01 Minimizing Sedation in Pediatric Neuroimaging

Thursday, Dec. 3 8:30AM - 8:50AM Location: S102D

#### Participants

A. James Barkovich, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### ABSTRACT

There are several keys to minimizing sedation in Pediatric Neuroimaging. Most important are targeting the study to obtaining the specific answer requested by the referring clinician, and obtaining the data as efficiently as possible by using sequences that will answer the question in the shortest time. The second is that the strategy changes depending upon the age of the patient: neonates most often can be scanned without sedation; a relatively short scan can be performed on infants by the 'feed and swaddle' method, and older children (6 years and above) can very frequently be studied without sedation if training and/or movies (to give them focus) are used. For neonates requiring a relatively short scan (is injury present or not), a useful technique is to feed the baby immediately before the procedure and then wrap them in a vacuum bean bag or wrap (swaddle) them in a blanket. Reducing noise by use of ear muffs, insulating the inner bore of the magnet, parallel imaging or ultra-short TE sequences can help, as can retrospective motion correction. Infants can also be scanned using feed and swaddle; it helps to do the scan during their nap time, if possible, and to take them to a quiet room with a parent so that they are asleep when placed in the MRI scanner. Use quiet sequences early in the study, saving the noisier ones for the end. Again, use of parallel imaging or ultra-short TE sequences helps to reduce noise. It is very difficult to image children between ages of 1 and 6 years without sedation. The goal is to scan efficiently. For older children, a training session before the scan to reduce anxiety is useful. Use of a system that allows the child to watch a movie of their own choice is very helpful as well.

#### RC651-02 Comparison of Non-sedated Brain MRI and CT for the Detection of Acute Traumatic Injury in Children Less than 5 Years Old

Thursday, Dec. 3 8:50AM - 9:00AM Location: S102D

#### Participants

Joseph Y. Young, MD, Boston, MA (*Presenter*) Nothing to Disclose  
Ann-Christine Duhaime, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Paul A. Caruso, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Ari Cohen, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Jean Klig, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Sandra Rincon, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

The 2014 ACR Appropriateness Criteria consider CT the first line study for acute intracranial injury in children because of its wide availability, detection of acute hemorrhage, and lack of sedation. A tailored MRI study with rapidly acquired sequences can obviate the need for sedation and radiation. We compared the sensitivity of rapid non-sedated brain MRI and CT for the detection of traumatic head injury in young children.

### METHOD AND MATERIALS

We reviewed a consecutive series of children less than 5 years old who presented to our ED during a 5 year period with head trauma and received a non-sedated brain MRI and CT within 24 hours of injury. Most MRI studies were limited to triplane T2 and susceptibility sequences. A few studies had additional sequences, including FLAIR and DWI, if clinically indicated and if the patient could tolerate a longer exam. Two neuroradiologists concurrently reviewed the MRI and CT studies on separate days and assessed

for the following five findings: fracture, epidural hematoma (EDH)/subdural hematoma (SDH), subarachnoid hemorrhage (SAH), intraventricular hemorrhage (IVH), and parenchymal injury.

## RESULTS

27 patients met inclusion criteria with a mean age of 21 months. A total of 49 abnormalities was noted in 25 patients, with 21 patients having intracranial findings. There was 79% agreement between the two modalities assessing for the presence of fracture, EDH/SDH, SAH, IVH, and parenchymal injury for each patient. CT missed 13 findings which included 6 EDH/SDH, 5 SAH, and 2 parenchymal injuries. MRI missed 13 findings which included 10 non-displaced fractures (of 17 fractures), 2 small EDH/SDH, and 1 SAH. The CT was negative for 4 patients in whom the MRI demonstrated intracranial findings (4 EDH/SDH, 2 SAH, 2 parenchymal). MRI was negative in 1 patient for whom CT had intracranial findings (1 small EDH/SDH).

## CONCLUSION

Non-sedated MRI is at least as sensitive as CT for the detection of intracranial injury in young children presenting with acute head trauma, though missed 10 of 17 fractures. Non-sedated MRI may be a useful alternative to CT in select populations. Low-dose CT may be obtained when fracture detection is clinically indicated.

## CLINICAL RELEVANCE/APPLICATION

Non-sedated MRI may be a useful alternative to CT for young children presenting with acute head trauma, thereby avoiding associated radiation risks.

### RC651-03 Quantifying the Radiation Dose Savings of Implementing an Ultra-Fast Brain MRI Protocol for Children with Hydrocephalus

Thursday, Dec. 3 9:00AM - 9:10AM Location: S102D

#### Participants

Daniel Durand, MD, Baltimore, MD (*Presenter*) Stockholder, Evolent Health, LLC; Advisor, National Decision Support Company; Advisor, Radiology Response; Founder, am-I-ok.com  
Mahadevappa Mahesh, MS, PhD, Baltimore, MD (*Abstract Co-Author*) Author with royalties, Wolters Kluwer nv  
Thierry Huisman, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Eric M. Jackson, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Allison Greene, BS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Siyuan Cao, BS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Aylin Tekes, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Children with shunted hydrocephalus frequently require neuroimaging to evaluate shunt function. For a number of practical reasons including length of study, need for sedation, and scanner availability, CT is favored over MRI at most centers. Children are also more susceptible than adults to radiation-induced cancer, with empirical evidence showing that the pediatric brain is particularly prone to cancers associated with CT. Previous reports have shown that ultrafast MRI can be used in place of head CT for evaluating hydrocephalus without any loss of sensitivity or specificity. The purpose of our study was to quantify the net radiation dose savings associated with transitioning from head CT to ultrafast brain MRI in this population.

## METHOD AND MATERIALS

An ultra-fast brain MRI protocol without sedation/anesthesia with an average scan time under 5 min was implemented for children with shunted hydrocephalus. A RIS query was designed to extract all neuroimaging orders for obstructive hydrocephalus for two time periods: a 3 month baseline period and a 6 month post-intervention period. The number of CTs performed per month was determined for each period and used to determine the number of cases avoided per month. Size-specific dose estimates for 30 patients in the baseline group were determined using measurements of anteroposterior and mediolateral head diameter as well as CT DIvol and scan length data stored on the PACS. The average dose per case and the CT avoidance rate were used to yield estimates of the annual radiation dose savings to the population in units of size-specific dose estimate (mGy) and age-adjusted effective dose (mSv).

## RESULTS

The pre- and post-intervention imaging rates were 20.7 and 8.5, yielding a CT avoidance rate of 12.2 per month. The mean size-specific dose estimate (Figure 1) per CT was 30.40 mGy and the mean age-adjusted effective dose was 1.76 mSv. The annual population radiation dose savings was 4,450 mGy and 258 mSv.

## CONCLUSION

Implementing a standard protocol to encourage the use of ultrafast brain MRI in place of head CT significantly reduced the annual radiation dose to pediatric patients imaged for hydrocephalus.

## CLINICAL RELEVANCE/APPLICATION

Our results show the benefit of using ultrafast brain MRI in place of head CT for suspected hydrocephalus. The method used here to quantify population radiation dose savings can be used more generally to highlight the value that radiologists and medical physicists bring to care pathway redesign.

### RC651-04 Silent MRI Reduces Children's Risk by Decreasing Need for Additional Sedation

Thursday, Dec. 3 9:10AM - 9:20AM Location: S102D

#### Participants

Chisato Matsuo, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yoshiyuki Watanabe, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hisashi Tanaka, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hiroto Takahashi, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Atsuko Arisawa, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Noriyuki Tomiyama, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose

Eri Yoshioka, MD, Matsubara, Japan (*Presenter*) Nothing to Disclose  
Shin Nabatame, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Sayaka Nakano, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Matthew W. Lukies, MBBS, Osaka, Japan (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Sedated children often wake up during magnetic resonance imaging (MRI) and additional sedatives are needed; the acoustic noise during the MR scanning might be the main cause of this. We hypothesized that silent MRI would decrease the frequency of arousal and additional administration of sedatives during examinations when compared with conventional MRI.

## METHOD AND MATERIALS

Twenty-eight children (M:F=18:10, age 13 months-8 years, mean 4.3 years, median 5 years) who underwent silent brain MRI from January to August in 2014 were retrospectively compared to 26 children (M:F=10:16, age 4 months-8 years, mean 4.0 years, median 3 years) who underwent conventional brain MRI from May to December in 2013 with the same 3T MR unit. The pediatrician administered intravenous sedatives including thiopental to all patients. Data from the medical chart of each patient was reviewed as follows: administered sedatives, doses, and need for additional intravenous injections during examinations. Unpaired t-test was used in the statistical analysis of the initial dose of thiopental. The need for additional sedation was assessed by Fisher's exact test.

## RESULTS

The mean initial dose of thiopental was 3.1 mg/kg for conventional MRI group and 3.3 mg/kg for silent MRI group. There was no significant difference between the two groups ( $p=0.55$ ). Ten out of twenty-six patients (38%) woke up during conventional MRI and additional sedatives were needed. On the other hand, three out of twenty-eight patients (11%) woke up during silent MRI and required additional sedatives. There was a significant difference between the two groups ( $p=0.02$ ).

## CONCLUSION

Silent MRI decreased the frequency of arousal and additional intravenous sedation during examinations. This can reduce patient risk and may possibly reduce the amount of time required for examinations.

## CLINICAL RELEVANCE/APPLICATION

Silent MRI can reduce children's risk by decreasing the need for additional sedation and may possibly reduce the amount of time required for examinations; silent MRI is recommended in routine brain evaluation for children.

## RC651-05 High-pitch CT of the Chest in Newborns and Infants: Is Sedation or Breath-hold Still Necessary?

Thursday, Dec. 3 9:20AM - 9:30AM Location: S102D

### Participants

Ilias Tsiflikas, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Matthias Teufel, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Michael Esser, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Sergios Gatidis, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Ines Ketelsen, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Sabrina Fleischer, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group  
Speakers Bureau, Bayer AG  
Juergen F. Schaefer, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose

## PURPOSE

To evaluate feasibility and image quality of high-pitch computed tomography of the chest without sedation or breath-hold in newborns and infants under the age of 12 months.

## METHOD AND MATERIALS

IRB waived informed consent and approved this retrospective, HIPAA-compliant study. 88 patients (48 boys, age  $153 \pm 103$  days) received 123 high-pitch CT examinations (HPCT) of the chest between October 2010 and December 2014. All examinations were scanned in free breathing. 84 HPCT were without sedation or general anesthesia, whereas 39 examinations were performed in general anesthesia because of patients' clinical condition. 84/123 HPCT were contrast-enhanced. Tube voltage and current were determined according to our institutional weight-adopted standard scanning protocol (70-100 kV; 6 - 80 mAs). Image quality was evaluated by two experienced pediatric radiologists with respect to typical artifacts arising from movement, breathing or pulsation of the heart or pulmonary vessels (0 - no; 1 - moderate; 2 - severe artifacts). Effective dose ( $E_{eff}$ ) was estimated according to the European Guidelines on Quality Criteria for Multislice Computed Tomography.

## RESULTS

All examinations were performed without the notice of moving artifacts. In awake patients there was a higher frequency of moderate breathing artifacts (19/84 vs. 1/39,  $p<0.01$ ) and pulsation artifacts (19/84 vs. 8/39,  $p=0.79$ ), but in no examination severe artifacts could be detected. The overall dose was very low ( $0.52 \pm 0.30$  mSv). As expected the estimated  $E_{eff}$  was higher in contrast-enhanced examinations than in non-enhanced scans ( $0.58 \pm 0.33$  vs.  $0.40 \pm 0.18$  mSv). Further  $E_{eff}$  was higher in examinations in general anesthesia ( $0.61 \pm 0.42$  vs.  $0.48 \pm 0.22$  mSv), what might be explained due to a higher rate of contrast-enhanced scans (79% vs. 63%) in this patient group.

## CONCLUSION

High-pitch scanning allows the examination of the chest in newborns and infants without sedation or breath-hold in sufficient image quality and with low effective doses.

## CLINICAL RELEVANCE/APPLICATION

Newborns and infants undergoing chest CT can be examined without sedation or breath-hold without significant loss in image quality.



## **RC651-06 The Optimal Scanning Protocol of Prospective ECG-triggering DSCT Thoracic Angiography in Children with Tetralogy of Fallot**

Thursday, Dec. 3 9:30AM - 9:40AM Location: S102D

### Participants

Yanhua Duan, MD, Jinan, China (*Presenter*) Nothing to Disclose  
Ximing Wang, Jinan, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate the effect of 4 different scanning protocols (bolus-tracking technique, test-bolus technique, fixed delay time technique and "manual" bolus-tracking technique) on image quality and effective dose of prospective ECG-triggering DSCT thoracic angiography in children with TOF.

### METHOD AND MATERIALS

Eighty consecutive children (48 boys; mean age of 3.5 years; mean heart rate: 97 bpm) with known or suspected TOF were enrolled between December 2008 and September 2014 in our institute. All children underwent prospective ECG-triggering DSCT thoracic angiography. All patients were assigned to 4 groups randomly according to the different enhanced scanning protocols: bolus-tracking technique (n=20, group A), test-bolus technique (n=20, group B), fixed delay time (25s) technique (n=20, group C) and "manual" bolus-tracking technique (place the region of interest in the background at the level of four-chamber, a monitoring scanning started at 18s after injection, the acquisition was manually triggered at the moment that the contrast medium artifact in the right atrium began to disappear) (n=20, group D). Subjective image quality was independently assessed by two radiologists. The total effective dose (including premonitoring, monitoring scanning and angiographic scanning) were calculated.

### RESULTS

All prospective ECG-triggering DSCT angiographic scans were successful. The image quality scores of groups A, B, C and D were  $3.20 \pm 1.06$ ,  $3.10 \pm 1.12$ ,  $3.40 \pm 1.30$ ,  $4.15 \pm 0.81$ , respectively, there were significant differences among the four groups ( $p=0.012$ ). The total effective dose of groups A, B and C were  $(0.40 \pm 0.06)$ mSv,  $(0.56 \pm 0.14)$ mSv,  $(0.38 \pm 0.06)$ mSv,  $(0.39 \pm 0.09)$ mSv, respectively, there were significant differences among 4 groups ( $p=0.023$ ).

### CONCLUSION

The scanning protocol has a significant impact on the image quality with a significantly different radiation dose. Considered the image quality and radiation dose together, the optimal scanning protocol for patient with TOF was the "manual" bolus-tracking technique.

### CLINICAL RELEVANCE/APPLICATION

"Manual" bolus-tracking technique is an excellent scanning protocol for TOF patients.

## **RC651-07 Minimizing Sedation and Radiation in Pediatric Cardiovascular Imaging**

Thursday, Dec. 3 9:40AM - 10:00AM Location: S102D

### Participants

Rajesh Krishnamurthy, MD, Houston, TX (*Presenter*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation

### LEARNING OBJECTIVES

View learning objectives under main course title.

## **RC651-08 Minimizing Sedation in Pediatric Abdominal and Musculoskeletal MRI**

Thursday, Dec. 3 10:20AM - 10:40AM Location: S102D

### Participants

Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (*Presenter*) Research collaboration, General Electric Company; Consultant, Arterys; Research Grant, Bayer AG;

### LEARNING OBJECTIVES

View learning objectives under main course title.

### ABSTRACT

Sedation for pediatric MRI has multiple disadvantages. It confers risk of adverse events for what is an otherwise non-invasive procedure. Additionally, sedation contributes to cost, makes exam scheduling complex, and leads to inefficient imaging utilization. This presentation will present some approaches to reduce the incidence, duration, and depth of sedation for pediatric abdominal and musculoskeletal indications. An overview of child developmental approaches that reduce the incidence of sedation will be given. Then an approach for compact protocols to minimize duration of sedation will be presented. This will be followed by discussion of methods of managing respiratory motion artifacts without periods of suspended respiration, thus reducing depth of anesthesia.

## **RC651-09 High-pitch Low-dose Whole Body CT for the Assessment of Ventriculo-peritoneal Shunts in Pediatric Patients: An Experimental ex-Vivo Study in a Rabbit Model**

Thursday, Dec. 3 10:40AM - 10:50AM Location: S102D

### Participants

Ahmed E. Othman, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose  
Saif Afat, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Rastislav Pjontek, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Marc A. Brockmann, MD, Luebeck, Germany (*Abstract Co-Author*) Nothing to Disclose  
Omid Nikoubashman, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG  
Martin Wiesmann, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

To assess the sensitivity of whole-body Low-Dose CT (LD-CT) in pediatric patients, regarding the detection of ventriculo-peritoneal shunt (VP-shunt) complications in comparison to radiographic shunt series (SS), with special regards to radiation exposure, using an ex vivo rabbit model.

#### **METHOD AND MATERIALS**

In a first step, an optimized low dose CT imaging protocol, with low tube voltages (70 kVp and 80 kVp) was assessed on a 16 cm phantom regarding signal-to-noise ratio (SNR) and radiation dose (with and without iterative reconstruction). After defining the CT protocol with the lowest possible radiation dose, 12 VP-shunts were implanted in 6 rabbit cadavers (weight, 4 - 6 kg). 24 mechanical complications (extracranial and extraperitoneal malpositioning, breakages, disconnections) were induced in 6 VP-shunts. LD-CT scans with the lowest possible radiation doses (80 kVp; 4 mAs) as well as conventional SS were acquired. Blinded readings on image quality and diagnostic accuracy regarding shunt complications as well as radiation dose estimations were performed.

#### **RESULTS**

For the detection of shunt complications, LD-CT yielded a sensitivity of 1.0 for both readers. SS yielded a sensitivity of 0.79 for reader A and 0.71 for reader B with moderate agreement ( $\kappa=0.56$ ) (Figure). No false positive findings were registered. Mean effective radiation doses for LD-CT were as low as  $0.069 \pm 0.003$  mSv and therefore comparable to reported doses for SS (0.047 mSv - 0.086 mSv).

#### **CONCLUSION**

LD-CT allows accurate detection of VP-shunt complications in pediatric patients with higher sensitivity than SS and comparably low radiation exposure. Thus, LD-CT provides a potentially superior alternative to radiographic shunt series for imaging VP-shunts.

#### **CLINICAL RELEVANCE/APPLICATION**

The improvement of accurate diagnostic tools such as LD-CT might potentially reduce time-to-diagnosis and patient turnaround time and might therefore improve the poor outcome and quality of life for children with shunted hydrocephalus.

#### **RC651-10 Application of T1-weighted BLADE Sequences to Abdominal MR Imaging of Young Children: Comparison with Turbo Spin Echo Sequence**

Thursday, Dec. 3 10:50AM - 11:00AM Location: S102D

#### **Participants**

Kyusung -. Choi, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Young Hun Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jung-Eun Cheon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Ji-Eun Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hyun Suk Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Yu Jin Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Woo Sun Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
In-One Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

To evaluate the usefulness of T1-weighted BLADE sequences for axial T1-weighted abdominal imaging in small children who cannot hold their breath.

#### **METHOD AND MATERIALS**

Two different BLADE sequences with (IR-BLADE) and without inversion pulse (BLADE) were compared to TSE with six number of signal acquired (NSA) in fifteen consecutive pediatric patients (mean age of 4.4 years, range 0.5-8 years) who were incapable of holding their breath. The overall image quality, motion artifact, radial artifact, sharpness of hepatic vessels, renal corticomedullary differentiation and lesion conspicuity were retrospectively assessed by two radiologists in a qualitative manner, using four or five-point scaled scoring systems. Signal variations of each sequence were measured in the liver, muscle and air for quantitative comparison. The acquisition times of three sequences were compared.

#### **RESULTS**

IR-BLADE and BLADE showed improved overall image quality and reduced motion artifact compared with TSE ( $p<0.01$ ). IR-BLADE showed better edge sharpness of hepatic vessels and corticomedullary differentiation, compared with both BLADE and TSE ( $p<0.001$ ). Radial artifacts were only observed on IR-BLADE and BLADE. In seven patients with lesions, IR-BLADE showed improved lesion conspicuity, compared with both BLADE and TSE ( $p=0.023$ ). Both IR-BLADE and BLADE showed decreased signal variation in the liver, muscle and increased signal variation in the air, compared with the TSE. The mean acquisition times for IR-BLADE, BLADE and TSE were 3min 47s, 3min 32s, and 3min 26s respectively.

#### **CONCLUSION**

Application of BLADE technique with inversion pulse for the T1-weighted MR imaging of the pediatric abdomen resulted in improved image quality, tissue contrast and lesion conspicuity with a diminished respiratory motion artifact and a comparable acquisition time, compared with the conventional TSE sequence.

#### **CLINICAL RELEVANCE/APPLICATION**

IR-BLADE could be a promising alternative to conventional TSE sequence for T1-weighted abdominal imaging of small children.

#### **RC651-11 Performing Screening Lumbar Spine MRIs in Infants without Sedation - The L-Spine Feed and Sleep**

Thursday, Dec. 3 11:00AM - 11:10AM Location: S102D

## Participants

Nicholas V. Stence, MD, Aurora, CO (*Presenter*) Nothing to Disclose  
Patrick T. McCormick, MD, Aurora, CO (*Abstract Co-Author*) Nothing to Disclose  
David M. Mirsky, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Laura Z. Fenton, MD, Greenwood Village, CO (*Abstract Co-Author*) Nothing to Disclose  
John D. Strain, MD, Greenwood Village, CO (*Abstract Co-Author*) Nothing to Disclose  
John A. Maloney, MD, Denver, CO (*Abstract Co-Author*) Nothing to Disclose  
Brent O'Neill, MD, Aurora, CO (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The feed and sleep technique is used in infants to avoid general anesthesia during MRI. The method typically involves fasting an infant prior to exam, feeding and swaddling immediately before scanning until asleep. This technique is commonly used in children's hospitals for neonatal brain MRI, and has been described in the literature in brain and cardiac MRIs. We describe the application of this technique in our institution to outpatient screening lumbar spine MRIs ordered for sacral dimples in children less than 6 months of age.

## METHOD AND MATERIALS

This project was undertaken as an internal quality improvement project and therefore did not require IRB approval. The departmental Montage database (Montage Healthcare Solutions) was queried for the number of outpatient, non-contrast lumbar spine MRI exams performed in infants less than 6 months of age over the last 5 years. The number of exams performed as non-sedated feed and sleeps was extracted. The feed and sleep method is performed as follows: Infants are scheduled for exams between 7 p.m. and 9 p.m. Parents are instructed to keep the child awake and fasted for 3-4 hours prior to arrival in the department. On arrival, the MRI technologist aids the parents with swaddling and feeding the infant. Once the child is asleep, they are placed in the scanner and provided ear protection with both a headset and a Philips foam acoustic shield.

## RESULTS

From January 2009 through January 2014, 111 of 342 (32%) of outpatient screening lumbar spine MRIs were successfully performed using the feed and sleep method, compared to 52 of 98 (53%) exams performed March 2014 through March 2015. The average age of successful feed and sleep exams in the last year was 3.3 months. Over the last year, approximately 10% of the exams attempted as feed and sleeps required rescheduling with general anesthesia after the attempt was unsuccessful.

## CONCLUSION

Our institution was able to avoid the use of general anesthesia in 52 of 98 infants who required a screening lumbar spine MRI for sacral dimples. The successful use of this method has increased over the past 5 years. This is likely due to increased MRI technologist confidence and skill with the technique, as well as an increasing awareness of this technique among referring clinicians.

## CLINICAL RELEVANCE/APPLICATION

Wider application of this technique could lead to a reduction in general anesthesia for this type of exam, leading to decreases in cost and risk to the patient.

## RC651-12 A Retrospective Analysis of the Safety and Cost Implications of Pediatric Contrast Enhanced Ultrasound in a Single Centre

Thursday, Dec. 3 11:10AM - 11:20AM Location: S102D

## Participants

Gibran Yusuf, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose  
Maria E. Sellars, MD, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Annamaria Deganello, MD, London, United Kingdom (*Abstract Co-Author*) Speaker, Bracco Group  
David O. Cosgrove, MBCh, FRCR, London, United Kingdom (*Abstract Co-Author*) Research Consultant, SuperSonic Imagine; Research Consultant, Bracco Group; Speakers Bureau, Toshiba Corporation  
Paul S. Sidhu, MRCP, FRCR, London, United Kingdom (*Abstract Co-Author*) Speaker, Bracco Group; Speaker, General Electric Company

## PURPOSE

There are concerns over increasing use of ionising radiation in children. Contrast enhanced ultrasound (CEUS) offers a cheaper radiation free alternative licensed in adults, widely used in Europe for liver assessment but used "off-label" in non-liver indications. Pediatric CEUS is "off label", and safety has not been assessed. We retrospectively analyse the prevalence of adverse incidents in a cohort of paediatric CEUS and investigate the financial implication of subsequent reduced CT and MR imaging.

## METHOD AND MATERIALS

Pediatric ( $\leq 18$  yrs) CEUS examinations (January 2008 and March 2015) were analysed. Parental informed consent was obtained and any reaction considered related to the contrast examination was documented in the radiology report, with electronic patient records examined for reactions  $\leq 24$ hrs. Using tariffs calculated from National Institute of Clinical Excellence (UK) analysis; CEUS cost (\$168) was compared to the cost for CT (\$172) and MR (\$280) imaging, the normal diagnostic imaging pathway. The possible reduction in cost when CEUS would have precluded further imaging was calculated.

## RESULTS

240 paediatric CEUS were performed (144 male, 96 female, age range 1-18 years). The majority of studies were performed for characterising liver lesions (123/240; 51%) and trauma (86/240; 36%), with renal and vascular assessment the remaining. There were no immediate adverse reactions. Two patients (2/240; 0.8%) experienced delayed adverse reactions of transient hypertension (n=1) and transient tachycardia (n=1) deemed not due to the underlying disorder; neither were symptomatic.

## CONCLUSION

CEUS in children is "off label"; however, our experience shows paediatric CEUS is both safe and can offer a cost-effective imaging

modality.

#### CLINICAL RELEVANCE/APPLICATION

CEUS in paediatrics offers a safe, cost effective alternative to MR and CT imaging in a variety of settings without the risk of ionising radiation, iodinated contrast or risks of sedation which may otherwise be needed.

#### RC651-13 Sonographic Evaluation of MAGEC Growing Scoliosis Rods in Pediatric Patients

Thursday, Dec. 3 11:20AM - 11:30AM Location: S102D

##### Participants

Sara M. O'Hara, MD, Cincinnati, OH (*Presenter*) Author, Reed Elsevier; Stockholder, Reed Elsevier; Speakers Bureau, Toshiba Corporation; Medical Advisory Board, Toshiba Corporation

Peter F. Sturm, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Sarah E. Gilday, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Adjustable, magnetically controlled "growing" scoliosis rods (MAGEC rods) are increasingly used in pediatric patients, and require periodic adjustments and confirmation of lengthening following this non-invasive procedure. Previously, adjustable rods required open surgical procedures for lengthening. The purpose of our study was to determine if these MAGEC rods could be adequately visualized and measured with ultrasound, thereby minimizing radiation exposure from serial spine X-rays.

#### METHOD AND MATERIALS

All patients with recently implanted MAGEC rods were examined with ultrasound before and after their first transcutaneous magnetic rod lengthening procedures. Measurements obtained sonographically were compared with baseline scoliosis X-rays and the length programmed into the magnetic motor used to extend the rod. Measurements will also be compared with scoliosis X-rays obtained once or twice each year.

#### RESULTS

12 patients have been studied to this point (3 month period) - 6 female, and 6 male, between 6 and 10 years of age. All of the MAGEC rod components including extension motors and expandable rod segments were well visualized sonographically before and after lengthening procedure. All of the patients showed good correlation between post-op scoliosis measurements and first, pre-lengthening ultrasound measurements. 4 of the 13 patients rods showed less lengthening than expected based on the length programmed into the magnetic motor driver. All patients will be re-imaged in the next few months to quantify measurement reliability and compare with expected extension parameters.

#### CONCLUSION

MAGEC rods can be reliably imaged with ultrasound before and after transcutaneous lengthening procedures, thereby reducing radiation exposure. In addition, the ultrasound may offer additional confidence that the rods have in fact extended the length programmed into the magnetic motor.

#### CLINICAL RELEVANCE/APPLICATION

Ultrasound should be the preferred method for serial imaging of MAGEC adjustable scoliosis rods in pediatric patients to minimize exposure to ionizing radiation.

#### RC651-14 Low Dose Pediatric Chest CT: Radiation Dose Comparison of a 70 kVp CT Protocol and a 100 kVp Protocol Using a Tin Filter for Spectral Beam Shaping

Thursday, Dec. 3 11:30AM - 11:40AM Location: S102D

##### Participants

Meike Weidner, Mannheim, Germany (*Presenter*) Nothing to Disclose

Thomas Henzler, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

Holger Haubenreisser, Mannheim, Germany (*Abstract Co-Author*) Speaker, Siemens AG; Speaker, Bayer AG

Mathias Meyer, Mannheim, Germany (*Abstract Co-Author*) Speaker, Siemens AG; Speaker, Bracco Group

Sonja Sudarski, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (*Abstract Co-Author*) Institutional research agreement, Siemens AG

Wolfgang Neff, MD, PhD, Alzey, Germany (*Abstract Co-Author*) Nothing to Disclose

Claudia Hagelstein, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

With the introduction of 3rd generation dual-source CT two competitive techniques for further radiation dose reduction became clinically available. On the one hand the CT peak tube voltage can be decreased down to 70 kVp whereas on the other hand 100 kVp imaging can be combined with a dedicated 0.6 mm tin (Sn) filter behind the x-ray tube in order to filter-out low energy photons. We aimed to compare radiation dose in pediatric chest CT scans between 70kV and 100kVp-Sn acquisitions.

#### METHOD AND MATERIALS

All chest CT examinations were performed on a 3rd generation 2 x 192 slice dual source system (Somatom Force, Siemens Healthcare, Germany) using a pitch factor of 3.2 and automatic tube current modulation without any sedation. In total, 46 examinations were included in this study (mean age 5.8±5.9 years, 70kV n=26; 100Sn n=20). Radiation dose was compared by the CT dose index (CTDIvol), effective dose (ED) after ICRP guideline 103 and organ doses. The latter were calculated with commercially available software (Radimetrics, Bayer, Germany). Signal to noise ratio (SNR) was calculated for lung tissue.

#### RESULTS

CTDIvol was significantly lower in the 100 kVp-Sn examinations (0.26±0.13 mGy) when compared to 70kVp (0.81±0.73 mGy; p<0.0001). Accordingly, mean effective dose was significantly reduced when using 100 kVp-Sn (0.30±0.09 mSv) compared to 70kVp acquisitions (0.84±0.54 mSv; p<0.0001; Fig. 1). Organ doses were also significantly lower with the 100 kVp-Sn protocol

compared to the 70kVp protocol, e.g. breast dose with 100 kVp-Sn was 0.49 mSv vs. 1.57 mSv with 70kV, resulting in a factor of 3.2 ( $p < 0.0001$ ). SNR in lung tissue was comparable between both examination protocols ( $p = 0.1$ ).

## CONCLUSION

Both, tube voltage reduction to 70kV and Sn-filter based spectral shaping at 100kVp allow to acquire pediatric chest CT scans at sub-mSv dose levels. In direct comparison 100Sn even performs at lower dose levels. Consequently, chest CT scans without contrast agent should be performed with this technique.

## CLINICAL RELEVANCE/APPLICATION

Pediatric chest CT scans can be performed with sub-mSv dose levels when using either 70kVp tube voltage or spectral beam shaping with an additional tin filter at 100kVp (100 kVp-Sn). All pediatric chest CT scans without contrast agent should be acquired with 100 kVp-Sn.

## RC651-15 Comparative Assessment of New Generation CT Scanners for Pediatric Applications

Thursday, Dec. 3 11:40AM - 12:00PM Location: S102D

### Participants

Whal Lee, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1) Reviewing the mechanical development of CT machines. 2) Comparative Assessment of New Generation CT Scanners. 3) Knowing new applications and new pitfalls in scanning in children.

## ABSTRACT

Computed tomography scanner was introduced at 1974. The scan was sequential at that time, in which the gantry made a complete rotation to acquire an image of a slice. This conventional step-and-shoot technique needed a long scan time because of the interscan delays between the slices. In the late 1980's and early 1990's, spiral scanners were introduced. The gantry continuously rotates, while the table is continuously moving. This spiral scanning allowed fast and continuous acquisition of a complete set of volume image data. In 1998, multi-detector technology was announced with first 4 channels MDCT. Since then, the number of rows of detectors has ever increased, 8, 16, 64, 128 and reaching 320 in 2008. The fast rotation speed of gantry is essential for imaging of an organ. The gantry rotation times have been fast up to 270 msec. There is a machine of two X-ray tube and two detector systems in a gantry which allow only one forth rotation enough to make a slice of image and high pitch fast scanning. The wide detector CT and high pitch scanning is fascinating imaging method for child to overcome motion artifact and reducing radiation dose. However, we have to know the pitfalls in these new scan mode. The overscan range is larger than that of past and wide beam angle of wide detector scanner gave us geometrical unused radiation and that cannot be neglected. In this lecture we will review the mechanical development of CT machines and new applications and new pitfalls in scanning in children.

### Active Handout: Whal Lee

[http://abstract.rsna.org/uploads/2015/14044487/RC651-15\\_new\\_CT\\_ped\\_app\\_handout.pdf](http://abstract.rsna.org/uploads/2015/14044487/RC651-15_new_CT_ped_app_handout.pdf)

RC632

## Value-Added Initiatives for a Healthcare System

Thursday, Dec. 3 8:30AM - 10:00AM Location: S104A



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

### Participants

### Sub-Events

#### RC632A Value Creation in Radiology: Beyond the Total Value Equation

### Participants

Richard E. Heller III, MD, Chicago, IL (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand the difference between interpretive value and non-interpretive value and the concept of the Total Value Equation. 2) Understand how to illustrate where on the Operations Frontier Curve your practice or department wishes to place itself, and where you think you actually are. 3) Based on the above two objectives, be able to identify potential areas of improvement in your staffing model. (This course is part of the Leadership Track)

### ABSTRACT

The term 'value' is popular in health care, and while universally understood to be critical to success, it is also a concept that is complex and can be challenging to evaluate. This talk analyzes the idea of value and value creation in the radiology department, and uses the Total Value Equation as a framework to deconstruct the activities of the department into interpretive and non-interpretive. By understanding these ideas, the radiology practice leader is better able to manage their resources and maximize their value production.

#### RC632B Imaging Informatics

### Participants

Keith J. Dreyer, MD, PhD, Boston, MA (*Presenter*) Co-Chairman, Medical Advisory Board, Merge/IBM

### LEARNING OBJECTIVES

1) Develop an understanding of the essential Informatics skills required for a leader to be successful. 2) Develop an understanding of the common Informatics errors made by leaders in academic and private practices. 3) Acquire the skills of Informatics planning needed to ensure that the success of your organization is sustainable over time. (This course is part of the Leadership Track)

RC605

## Brain Aneurysms

Thursday, Dec. 3 8:30AM - 10:00AM Location: S102AB



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



Discussions may include off-label uses.

### Participants

Steven W. Hetts, MD, San Francisco, CA (*Moderator*) Consultant, Silk Road Medical Inc Consultant, Medina Medical Inc Research Grant, Stryker Corporation Data Safety Monitoring Board, Stryker Corporation  
Darren Orbach, MD, Boston, MA, (darren.orbach@childrens.harvard.edu) (*Moderator*) Nothing to Disclose

### Sub-Events

#### RC605A Management of the Unruptured Brain Aneurysm

##### Participants

Robert Fahed, MD, MSc, Quebec, QC (*Presenter*) Nothing to Disclose

##### Handout: Jean Raymond

[http://abstract.rsna.org/uploads/2015/15000018/RAYMONDJ\\_RC605A\\_61267.pdf](http://abstract.rsna.org/uploads/2015/15000018/RAYMONDJ_RC605A_61267.pdf)

#### RC605B Pediatric Arteriopathy: A Neurointerventionalist's Perspective

##### Participants

Darren Orbach, MD, Boston, MA, (darren.orbach@childrens.harvard.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand the most common causes of pediatric arterial ischemic stroke. 2) Contextualize arterial ischemic stroke within overall cerebrovascular conditions in children (hemorrhagic and venous). 3) Distinguish between progressive and fixed arteriopathies, in terms of natural history and treatment strategies. 4) Differentiate etiologies and treatment challenges of stroke in children versus adults.

### ABSTRACT

#### RC605C Flow-diversion Technology for Treatment of Cerebral Aneurysms

##### Participants

Philip M. Meyers, MD, New York, NY, (pmm2002@cumc.columbia.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) The participant will understand the design of certain flow-diverters used to treat cerebral aneurysms. 2) The participant will be familiar with the on-label and some off-label application of the most commonly used flow diverters in the United States. 3) The participant will be familiar with common radiographic outcome metrics, imaging markers for clinical success and potential complications.

### ABSTRACT

Flow diversion is becoming an increasingly important method to treat cerebral aneurysms, now encompassing nearly 40% of all endovascular treatment procedures for unruptured intracranial aneurysms. In this lecture, the meeting participant will learn about the design and application of flow diversion technologies to the treatment of cerebral aneurysms and about some of the imaging manifestations associated with their use.

RC625

## Radiomics Mini-Course: Oncologic Applications

Thursday, Dec. 3 8:30AM - 10:00AM Location: S103AB



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

### Participants

Sandy Napel, PhD, Stanford, CA (*Director*) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc

### Sub-Events

#### RC625A Breast Cancer with PET-CT

### Participants

Richard L. Wahl, MD, Saint Louis, MO (*Presenter*) Research Consultant, Nihon Medi-Physics Co, Ltd;

### LEARNING OBJECTIVES

1) Describe the FDG pet uptake characteristics before therapy of 'triple - negative' breast cancers vs other subtypes.

### ABSTRACT

#### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Richard L. Wahl, MD - 2013 Honored Educator

#### RC625B Radiogenomics of Lung Cancer

### Participants

Michael D. Kuo, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To discuss the principles behind lung cancer radiogenomics. 2) Highlight clinical applications of lung cancer radiogenomics.

### ABSTRACT

#### RC625C Brain Cancer: Radiomics, Radiogenomics, and Big Data

### Participants

Rivka R. Colen, MD, Houston, TX, (rcolen@mdanderson.org) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Define the field of radiomics and imaging genomics. 2) Apply radiomics and imaging genomics in brain tumors. 3) Describe the use of MRI as a biomarker for genomic signatures and profiles. 4) Define role of MRI in personalized medicine for target discovery of therapeutic targets. 5) Explain the use of MRI in drug development and clinical trials. 6) Assess the research available in imaging genomics and radiomics. 7) Define and describe the integration of radiomics and imaging genomics into big data platforms.

### ABSTRACT

This objective of this course is to introduce the recently emerged field of radiomics and imaging genomics (radiogenomics) in brain tumors, specifically glioblastoma (GBM). Emphasis will be on radiomics with regards to the high-dimensional, high-throughput feature extraction of imaging features from medical images, specifically MRI; the second emphasis will be on the use of imaging in relation to underlying tumor genomics, how to use MRI as a biomarker, surrogate and correlate of tumor genomics as well as the use of MRI as a genomic target discovery tool and its application in therapeutic discovery and drug development. The role of radiomics and imaging genomics in the era of big data and how we can leverage the imaging-omic data will also be discussed.



RC654

## Decision Support for Radiologists at the Time of Reporting

Thursday, Dec. 3 8:30AM - 10:00AM Location: S103CD



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

### Participants

Charles E. Kahn JR, MD, MS, Philadelphia, PA, (charles.kahn@uphs.upenn.edu) (*Moderator*) Nothing to Disclose

### Sub-Events

#### RC654A Structured Reporting

### Participants

Charles E. Kahn JR, MD, MS, Philadelphia, PA, (charles.kahn@uphs.upenn.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe the RSNA's initiative to create a repository of radiology report templates. 2) Explore new information standards for representing and exchanging report templates. 3) Discuss how report templates can increase compliance with practice guidelines. 4) Describe new opportunities to incorporate decision support into radiology reporting.

### Honored Educators

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Charles E. Kahn JR, MD, MS - 2012 Honored Educator

#### RC654B Improving the Quality of Follow-up Recommendations

### Participants

Tarik K. Alkasab, MD, PhD, Boston, MA, (talkasab@mgh.harvard.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe how informatics tools such as computer-assisted reporting/decision support can lead to more consistent radiologist recommendations for follow-up. 2) Describe how informatics tools will permit creation of 'structured recommendations'. 3) Discuss how these 'structured recommendations' can be used by downstream information systems.

#### RC654C Enabling Evidence-based Recommendations in Radiology Reports

### Participants

V. Anik Sahni, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe the importance of evidence-based recommendations in radiology reports. 2) Explore the IT solutions available to integrate evidence-based recommendations into radiology reports. 3) Discuss tools available to monitor consistency and compliance of recommendations.

RC611

## Advances in Cardiac Nuclear Imaging: SPECT/CT and PET/CT

Thursday, Dec. 3 8:30AM - 10:00AM Location: S504CD



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

### Participants

#### 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

#### RC611A Advances in Cardiac SPECT

##### Participants

E. Gordon Depuey, MD, New York, NY (*Presenter*) 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.

#### 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.

#### RC611B Advances in Cardiac PET

##### Participants

Sharmila Dorbala, MBBS, Boston, MA (*Presenter*) Research Grant, Astellas Group; Stockholder, 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.

#### ABSTRACT

Novel advances in PET detectors, radiotracer availability, clinical software, as well as hybrid PET/CT and PET/MR scanners have revolutionized the clinical and investigative applications of cardiac PET. Cardiac PET myocardial perfusion imaging, in the 1970's, was a predominantly investigative tool, with home-grown software, available at select major academic centers with access to a cyclotron. Over the last decade, with easy access to PET scanners, and to positron emitting perfusion tracers, the use of cardiac PET has exploded - well beyond major academic centers to several hospitals and to large office-based practices. Commercially available software has made quantitative myocardial blood flow assessment, a main-stream clinical application. Hybrid PET/CT scanner applications- calcium score and CT based coronary angiography- have further advanced the applications of cardiac PET. PET/MR is an emerging technology with promising cardiovascular applications. Each of these exciting developments has transformed cardiac PET from a predominantly investigative tool of the 1970's to the advanced clinical tool of the 2015. The primary goal of this session is to discuss the present-day clinical and emerging applications of cardiac PET/CT and PET/MR using a practical case-based approach.

RC623

## MR Safety I

Thursday, Dec. 3 8:30AM - 10:00AM Location: S105AB

**NR** **MR** **PH** **SQ**

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

**FDA** Discussions may include off-label uses.

### Participants

Joel P. Feimlee, PhD, Rochester, MN (*Director*) Nothing to Disclose

### Sub-Events

#### RC623A MRI Safety - Rules, Regulations, and Concepts

### Participants

Karl Vigen, PhD, Madison, WI (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand safety issues in MRI, particularly those caused by the main magnetic field, magnetic field gradients, and transmit RF. 2) Understand guidance from the ACR, and governmental regulations designed to address these issues. 3) Describe the importance of an MR Safety program including comprehensive patient screening in the clinical setting. 4) Briefly address safety issues regarding MRI contrast agents.

#### RC623B MRI Safety of Deep Brain and Other Simulators

### Participants

Yunhong Shu, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe various types of neurostimulators and their clinical applications. 2) Understand the underlying MR physics associated with the risks of scanning patients with neurostimulators. 3) Learn the precaution steps to ensure the safety of the patient with neurostimulators during MR scanning.

### ABSTRACT

The demands and applications for neurostimulators continue to increase as the technology advances. MRI is an important diagnostic tool for postoperative evaluation and potential future workup. The presence of the neurostimulator poses potential safety risks in the MR scanning environment. By observing certain precautions, MRI can be performed with an extremely low risks. It is important to follow the manufactures' MRI guidelines to ensure the safety of the patients and continuous functioning of the device.

MSRT52

## ASRT@RSNA 2015: Patient-centered Imaging and the Role for the RA in a Changing Healthcare Environment

Thursday, Dec. 3 9:15AM - 10:15AM Location: N230



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

### Participants

Courtney Sullivan, MS, RRA, New York, NY, (cls2007@med.cornell.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Define approaches to providing patient-centered care through radiology consultation activities. 2) Identify the value of the role of the registered radiologist assistant in the patient care setting. 3) Understand ways in which radiology consultation can increase the standard of care in a changing healthcare environment.

### ABSTRACT

In a changing healthcare environment, the ability to provide patient-centered care has become increasingly more important. Aligning with healthcare reform initiatives, consultation provides an ideal opportunity to promote informed decision making, increase education, and facilitate communication between patients, radiologists and referring physicians. While radiology consultation has traditionally been a part of standard clinical practice, the current fee for service payment model and technologies such as PACS have limited the availability of the radiologist. Through an organized consultation service, the role of the Registered Radiologist Assistant offers potential to help alleviate radiologist workflow constraints that come with participating in non-interpretive tasks. In reviewing this model, this session will focus on radiology consultation and ways to promote patient-centered imaging, ultimately increasing the quality of care that is received.

MSRT53

## ASRT@RSNA 2015: 3D Post Processing - Not Just a Pretty Picture

Thursday, Dec. 3 10:30AM - 11:30AM Location: N230



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

### Participants

Adrienne Coya, MS, RRA, New York, NY, (abc2011@med.cornell.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Define key 3D post processing terminology and techniques. 2) Identify where 3D post processing can improve diagnostic accuracy on CT and MRI exams. 3) Examine the role of 3D post processing in surgical and treatment course planning.

SSQ17

## Neuroradiology (Advanced Neuroimaging of Alzheimer Disease)

Thursday, Dec. 3 10:30AM - 12:00PM Location: N229



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

Discussions may include off-label uses.

### Participants

Duygu Tosun, San Francisco, CA (*Moderator*) Research Grant, Eli Lilly and Company  
Gloria C. Chiang, MD, San Francisco, CA (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ17-01 Hippocampus MRI T1 Texture's Relation to Established Alzheimer's Disease Biomarkers and Prediction of Progression

Thursday, Dec. 3 10:30AM - 10:40AM Location: N229

### Participants

Mads Nielsen, PhD, Copenhagen, Denmark (*Presenter*) Stockholder, Biomediq A/S Research Grant, Nordic Bioscience A/S Research Grant, SYNARC Inc Research Grant, AstraZeneca PLC  
Lauge Sorensen, Copenhagen, Denmark (*Abstract Co-Author*) Research funded, Biomediq A/S  
Akshay Pai, Copenhagen, Denmark (*Abstract Co-Author*) Nothing to Disclose  
Christian Igel, Copenhagen, Denmark (*Abstract Co-Author*) Research funded, Biomediq A/S  
Martin Lillholm, PhD, Copenhagen, Denmark (*Abstract Co-Author*) Employee, Biomediq A/S Shareholder, Biomediq A/S

### PURPOSE

The hippocampus texture as recorded in T1 MRI has been shown to be a strong predictor of conversion from MCI to probable AD and has been suggested for enrichment of AD trials. We investigate the relation of the hippocampal texture to CSF amyloid and tau load, and glucose metabolism of the hippocampus and its potential prediction of conversion in amyloid and tau positive subject respectively.

### METHOD AND MATERIALS

The study dataset consisted of the 504 subjects from the "complete annual year 2 visits" standardized Alzheimer's Disease Neuroimaging Initiative (ADNI) dataset including 234 baseline MCI subjects. MRI analysis consisted of segmenting the hippocampi using cross-sectional FreeSurfer (v.5.1.0), computation of the baseline hippocampal fraction (HF, hippocampal volume divided by intra-cranial volume), hippocampal atrophy (baseline, 12 month, 24 month regression percentage volume loss), and texture scoring of the hippocampus using our in-house method. CSF amyloid (AB42), respectively total tau (t-tau), and tau phosphorylated at the threonine 118 position (p-tau) were defined as positive by AB42  $\leq$  192 pg/ml, t-tau  $\geq$  93 pg/ml, and p-tau  $\geq$  23 pg/ml. Normalized FDG-PET measurements constrained to the hippocampus were averaged over left and right hippocampus. Age and gender adjustment was performed.

### RESULTS

The subpopulations having available amyloid, tau, and FDG-PET measurements did not significantly differ from the full 504 subjects in age, gender, MMSE, or HF. Hippocampal texture predicted conversion from MCI to AD in 12 months with an AUC of 0.71. In AB42, p-tau and t-tau positive subjects, the AUC of MCI to AD conversion were respectively 0.71, 0.72, and 0.69 (not significantly different from the whole population). The Pearson's R between hippocampus texture and AB42, p-tau, t-tau, FDG-PET, and hippocampal atrophy was respectively -0.32, 0.31, 0.28, -0.62, and 0.50. All AUC's and R's remained significant after decorrelation using HF.

### CONCLUSION

Hippocampal texture predicts MCI-to-AD conversion independent of AB42, p-tau, t-tau. It relates weakly to AB42, p-tau, t-tau and strongly to glucose metabolism and future hippocampal atrophy.

### CLINICAL RELEVANCE/APPLICATION

Hippocampus MRI T1 texture is a promising marker for prediction of fast Alzheimer's progression and enrichment of clinical trials.

#### SSQ17-02 Default Mode Network Structural-functional Connectivity and Beta-Amyloid Pathology in Autosomal Dominant Familial Alzheimer's Disease

Thursday, Dec. 3 10:40AM - 10:50AM Location: N229

### Awards

#### Trainee Research Prize - Resident

### Participants

Jeffrey W. Prescott, MD, PhD, Durham, NC (*Presenter*) Nothing to Disclose  
P. M. Doraiswamy, MD, Durham, NC (*Abstract Co-Author*) Research Consultant, Bristol-Myers Squibb Company Research Consultant, Eli Lilly and Company Research Consultant, Neuronetrix, Inc Research Consultant, Medivation, Inc Research Grant, Bristol-Myers Squibb Company Research Grant, Eli Lilly and Company Research Grant, Neuronetrix, Inc Research Grant, Medivation, Inc Stockholder, Sonexa Therapeutics, Inc Stockholder, Clarimedix, Inc Speaker, Forest Medical, LLC  
Jeffrey R. Petrella, MD, Durham, NC (*Abstract Co-Author*) Advisory Board, Johnson & Johnson Speakers Bureau, Quintiles Inc Advisory Board, Piramal Enterprises Limited

## PURPOSE

Early onset familial Alzheimer's disease (FAD) is inherited in an autosomal dominant manner and provides a model for studying how amyloid may affect disease onset and synaptic failure. Our goal was to use data from Dominantly Inherited Alzheimer's disease Network (DIAN) to evaluate relationships between structural connectivity, functional connectivity, and amyloid burden.

## METHOD AND MATERIALS

Baseline data from controls and mutation carriers from the national DIAN study were analyzed. Subjects' T1 scans were automatically segmented using FreeSurfer. A standard functional parcellation atlas was mapped to each subject (Yeo et al, J Neurophysiol, 2011). Functional connectivity was calculated as the average timeseries correlation among regions in the DMN of the functional atlas. Structural connectivity was calculated as the global efficiency of the tractographic connections between regions in the DMN, weighted by the number of fibers. Whole cortex amyloid SUVR was calculated from Pittsburgh compound B PET images, performed by the DIAN imaging core group. A general linear model examined the relationship between functional connectivity, structural connectivity and amyloid burden after covarying for age, sex, education, cognitive status (MMSE), and genetic mutation status (yes or no). Also, a correlation analysis was performed to examine relationships between structural-functional connectivity, age, and mutation status. A p-value less than 0.05 was considered significant.

## RESULTS

76 subjects from DIAN were analyzed. 38 subjects had an FAD mutation (24 normal cognition (NC), 3 mild cognitive impairment (MCI), 11 dementia (AD)). 38 subjects did not have an FAD mutation (37 NC, 1 MCI). There was a significant association between functional and structural connectivity; specifically, as structural global efficiency decreased, functional timeseries correlation decreased. Functional and structural connectivity significantly decreased with age in mutation carriers, but not in controls.

## CONCLUSION

Among DIAN subjects, there is a significant association between functional and structural connectivity metrics. There is a significant decrease in functional and structural connectivity with increasing age in mutation carriers, but not in controls.

## CLINICAL RELEVANCE/APPLICATION

Evaluation of structural-functional connectivity breakdown in subjects with FAD may provide imaging biomarkers for patients in the preclinical stages of AD.

## SSQ17-03 Comparison of Several Computational Pipelines for Atrophy Computation in Longitudinal Alzheimers Studies

Thursday, Dec. 3 10:50AM - 11:00AM Location: N229

### Participants

Akshay Pai, Copenhagen, Denmark (*Presenter*) Nothing to Disclose

Stefan Sommer, PhD, Copenhagen, Denmark (*Abstract Co-Author*) Nothing to Disclose

Sune Darkner, Copenhagen, Denmark (*Abstract Co-Author*) Nothing to Disclose

Lauge Sorensen, Copenhagen, Denmark (*Abstract Co-Author*) Research funded, Biomediq A/S

Jon Sparring, Copenhagen, Denmark (*Abstract Co-Author*) Co-founder, DigiCorpus ApS Shareholder, DigiCorpus ApS

Mads Nielsen, PhD, Copenhagen, Denmark (*Abstract Co-Author*) Stockholder, Biomediq A/S Research Grant, Nordic Bioscience A/S Research Grant, SYNARC Inc Research Grant, AstraZeneca PLC

## PURPOSE

To evaluate the newly developed diffeomorphic image registration framework using stationary velocity fields parameterized by wendland kernel bundle framework in atrophy estimation. In this study, we compare the diagnostic group separation (Alzheimer's and Normals) abilities of the proposed framework against other state-of-art registration schemes and the Boundary shift integral (BSI) based on atrophy scores in several brain regions.

## METHOD AND MATERIALS

Baseline and month 12 MRI scans from the "complete annual year 2 visits" 1.5-T standardized ADNI dataset were used [169 normal controls (NC), 101 AD]. Segmentations for atrophy quantifications were obtained using FreeSurfer cross-sectional pipeline. Each image was corrected for intensity inhomogeneities using N3 from FreeSurfer. Each of baseline and month 12 scans were non-linearly aligned using the proposed framework and existing methods like SyN, NiftyReg, LCC-Demons. Atrophy was then estimated from the deformation field of the proposed framework using the proprietary Cube Propagation and on the rest, using Jacobian determinants. Atrophy was estimated in the regions of whole brain (WB), hippocampus (Hip), Ventricles, Medial temporal lobe (MTL), Cortical gray matter (CGM), entorhinal cortex (ENCTX) and fusiform gyrus (FG). BSI was also used to evaluate atrophy in the regions of WB, Hip and Ventricles.

## RESULTS

The proposed framework yields better AUC and Cohens'D for AD v/s NC when compared to the other registration schemes. The highest separation (AUC/Cohen's D) among the registration frameworks was using the proposed framework - WB 0.76/ 0.94, hippocampus 0.82/1.26, MTL 0.86/1.43, CGM 0.85/1.29, ENCTX 0.80/1.13 and FG 0.76/0.98. Overall, BSI provided a better separation on WB (0.81/1.18), hippocampus (0.86/1.15). However, BSI was not designed to provide scores for any other region.

## CONCLUSION

Although, BSI provides a better separation, the method can be used only in regions the software is designed for, for instance whole brain, hippocampus and ventricles. The proposed registration framework not only provides good comparable group separation (and better than other registration frameworks), it provides the flexibility to measure atrophy in any user-defined region.

## CLINICAL RELEVANCE/APPLICATION

The proposed method can reliably estimate atrophy in any brain region unlike BSI which is specifically designed to estimate atrophy only in certain regions of the brain.

## SSQ17-04 Altered Spontaneous Activity in aMCI and AD Revealed by Resting-state fMRI

Thursday, Dec. 3 11:00AM - 11:10AM Location: N229

#### Participants

Hong Xiang Yao SR, PhD, Beijing, China (*Presenter*) Nothing to Disclose  
Ning Yu An, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To distinguish Alzheimer's disease(AD) and amnesic mild cognitive impairment(aMCI) from healthy aging by the alteration of amplitude in the time domain(AM) in resting-state fMRI.

#### METHOD AND MATERIALS

We hypothesized that AD and aMCI patients show abnormal AM of intrinsic brain activity in some specific regions. To prove this hypothesis, we recruited 35 AD patients, 27 aMCI patients and 27 age- and gender-matched normal controls(NC) and they all received resting-state fMRI examination and neuropsychological tests. Then, we investigated the altered AM patterns in aMCI and AD compared with the NC group. In addition, we also expected to find the relationship between the strength of AM and the cognitive abilities of the aMCI and AD subjects compared with NC.

#### RESULTS

At the voxel level, two regions (that's the posterior cingulate cortex (PCC)/precuneus (PCu) and the left caudate) were identified showed significant altered AM values (Figure 1, A). Post hoc analysis showed that the main difference was found between the AD and NC subjects (Figure 1, B)At the regions level, compared with NC, totally 28 regions were found with significant impaired AM value in aMCI and AD subjects. According to the altered pattern and anatomical locations, these regions can be combined into five clusters which includes the PCC/PCu, cuneus (Cun), right caudate, left caudate, left inferior temporal gyrus (ITG) (Figure 2). Compared with NC and aMCI subjects, the most obvious areas of change located in the three regions including PCC/PCu, Cun and left caudate in AD (Figure 3). Compared with normal controls, only the region of PCC/PCu showed decreased AM value in aMCI. Importantly, the alteration of AM was significantly correlated with cognitive abilities measured by MMSE(Figure 4).

#### CONCLUSION

AM is a useful method to distinguish AD and aMCI from NC. Our results indicated that default mode network and the other cortical regions had been destroyed in aMCI and AD, which might be a potential biomarker for early diagnosis of aMCI and AD.

#### CLINICAL RELEVANCE/APPLICATION

AM is a new method of resting-state fMRI and helpful for the early diagnosis of AD and aMCI.

#### SSQ17-05 Quantitative MR R2\* Imaging and Arterial Spin Labeling Brain Perfusion Assessment in Alzheimer Disease

Thursday, Dec. 3 11:10AM - 11:20AM Location: N229

#### Participants

Marica T. Maccarone, MD, PhD, Chieti, Italy (*Abstract Co-Author*) Nothing to Disclose  
Roberto Esposito, MD, PhD, Chieti, Italy (*Abstract Co-Author*) Nothing to Disclose  
Simone Salice, MD, Chieti, Italy (*Abstract Co-Author*) Nothing to Disclose  
Giacomo Caracciolo, Chieti, Italy (*Abstract Co-Author*) Nothing to Disclose  
Stefano Delli Pizzi, Chieti, Italy (*Abstract Co-Author*) Nothing to Disclose  
Piero Chiacchiaretta, Chieti, Italy (*Abstract Co-Author*) Nothing to Disclose  
Antonio Ferretti, PhD, Chieti, Italy (*Abstract Co-Author*) Nothing to Disclose  
Armando Tartaro, MD, Chieti, Italy (*Presenter*) Nothing to Disclose

#### PURPOSE

Cerebral iron deposition plays a key role in pathophysiology of neurodegenerative processes. Iron concentrations are elevated in cortical and basal ganglia regions in Alzheimer Disease (AD), indicating a disruption of its homeostasis. Higher iron concentrations in AD may increase the possibility of free iron catalyzing lipid peroxidation leading to cell membrane damage and cell death. The aim of this study is to investigate the correlation of brain iron accumulation with the severity of vascular damage and cerebral perfusion in mild-AD patients.

#### METHOD AND MATERIALS

18 mild-AD patients evaluated by means of neuropsychological tests were enrolled in the study and compared with 18 aged matched healthy volunteers. Iron concentration was derived from R2\* measurements obtained with multi-echo gradient echo sequences (1 mm in-plane resolution, slice thickness 4 mm, 30 axial slices; TR= 68 ms; TE1=4.9 ms, delta TE = 4.9 ms, 12 echoes) and data were collected from 14 ROI in cortical and subcortical grey matter. Regional cerebral blood flow (CBF) was obtained by means of a pseudocontinuous Arterial Spin Labeling (pCASL) sequence (T2\* EPI; TR/TE = 4000/11 ms, 35 tag-control volumes consisting of 19 slices with 3.5x3.5x6 mm<sup>3</sup> resolution; label duration = 1650 ms, post label delay = 1600 ms, background suppression pulses). Vascular damage was evaluated on conventional images according to Fazekas scale.

#### RESULTS

R2\* shows a significant correlation with the severity of white matter vascular damage in the right frontal cortex (p>0.05) and with Mini Mental State Examination (MMSE; p<0.02) in the left frontal cortex in mild AD group compared to controls. CBF modifications in mild-AD patients shows no significant correlation with MMSE and a significant correlation with vascular damage (p<0.05) in the left lateral orbito-frontal cortex. Moreover a significant decreased CBF was observed in bilateral nucleus caudatus in mild-AD group (p<0,05) compared to controls.

#### CONCLUSION

Iron concentration positively correlates with the severity of vascular impairment and negatively correlates with CBF in mild-AD patients, indicating that it may be used as biomarkers to evaluate the progression of AD.



## CLINICAL RELEVANCE/APPLICATION

Quantification of brain metal ion content and distribution may be a predictive marker for early diagnosis, assessment of treatment strategies or therapeutic target in AD.

### SSQ17-06 A Follow-up Study of Disrupted Functional Brain Connectivity in Alzheimer's Disease

Thursday, Dec. 3 11:20AM - 11:30AM Location: N229

#### Participants

Xiangzhu Zeng, MD, Beijing, China (*Presenter*) Nothing to Disclose  
Huishu Yuan, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Ying Liu, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Zheng Wang, MS, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The change patterns of damage on neural networks of Alzheimer's disease (AD) is still largely uncertain. The aim of this study is to investigate cerebral network changes of AD patients in about 1.5 years.

#### METHOD AND MATERIALS

Patients with AD (n=15, 4men, mean age 72.1 ±6.21 years, mean MMSE scores for first examination 19.6±6.13, mean scores for second examination 19.4±5.28) and healthy control subjects (HC, n=15, 6men, mean age 68.3±8.22 years, mean MMSE scores 29.2±0.92) were recruited. Resting-state functional data was obtained using a single-shot echo-planar imaging (EPI) sequence on SIEMENS TrioTim 3T scanner. The acquisition parameters were as following: EPI sequence TR=2000ms, TE= 30ms, slice thickness= 5 mm, slices=30, voxel size= 3.4×3.4×5.0 mm<sup>3</sup>, scan time=7min. HC subjects were scanned once and all AD patients were examined twice. The average scanning interval was 16.8±11.33 months in AD patients. All resting-state fMRI data were processed by GRETNA, small world parameters of global and local network were obtained including Gamma, Lambda, normalized regional nodal efficiency (EFi) and betweenness (BCi).

#### RESULTS

Small-world parameters of AD-First and AD-Second slightly decreased compared with HC respectively (Sparsity 10%-30%) (Fig1). For nodal EF, AD-First in left inferior parietal (r=0.44, p=0.02), right angular gyrus (r=0.42, p=0.03), left rectus (r=0.40, p=0.03) and AD-Second in right superior orbital Frontal lobe (r=0.40, p=0.04), right supplementary motor area (r=0.40, p=0.04), bilateral rectus (r=0.43, p=0.02 for left, r=0.45, p=0.01 for right) are positive correlation with MMSE score (Fig2). Nodal BC on AD-First in right medial orbital frontal lobe (r=0.40, p=0.03) is positive and in right precuneus (r=-0.42, p=0.02) is negative correlation with MMSE; BC on AD-Second in bilateral supplementary motor areas (r=0.46, p=0.02 for left, r=0.47, p=0.01 for right) and right medial orbital frontal lobe (r=-0.41, p=0.03) are positive correlation with MMSE (Fig2). (r>=0.4 or r<=-0.4, p<0.05)

#### CONCLUSION

Brain network had a slight decline in the optimal small-world architecture in the progression of AD. The involved nodes which have positive and negative correlation of nodal BC and EF with MMSE score exhibited underlying dynamic disrupted patterns of functional connectivity in AD.

## CLINICAL RELEVANCE/APPLICATION

Resting-state fMRI is a useful noninvasive tool to identify the disrupted functional connectivity in progression of AD.

### SSQ17-07 Comprehensive, Radiological Evaluation of Strategic Structures in Patients with Mild Cognitive Impairment and Early Alzheimer's Disease

Thursday, Dec. 3 11:30AM - 11:40AM Location: N229

#### Participants

Tomasz Nesteruk, MD, Warsaw, Poland (*Abstract Co-Author*) Nothing to Disclose  
Marta J. Nesteruk, MD, Warsaw, Poland (*Abstract Co-Author*) Nothing to Disclose  
Maria Styczynska, PhD, Warsaw, Poland (*Abstract Co-Author*) Nothing to Disclose  
Jerzy M. Walecki, MD, PhD, Warszawa, Poland (*Presenter*) Nothing to Disclose

#### PURPOSE

The aim of the study was to evaluate the diagnostic value of two measurement techniques in patients with cognitive impairment. The first was automated volumetry of the hippocampus, entorhinal cortex, parahippocampal gyrus, posterior cingulate gyrus, cortex of the temporal lobes, corpus callosum and the second was fractional anisotropy (FA) measurements of the corpus callosum in diffusion tensor imaging technique.

#### METHOD AND MATERIALS

Ninety six patients underwent brain magnetic resonance imaging - 33 healthy controls (HC), 33 patients with diagnosed mild cognitive impairment (MCI) and 30 patients with probable AD of mild degree (AD). Severity of the dementia was evaluated with the neuropsychological battery test. Volumetric measurements were performed automatically with FreeSurfer imaging software. Measurements of the FA values were performed manually with region of interest tool.

#### RESULTS

Volumetric measurement of the temporal lobe cortex had the highest correct classification rate - 68.7%, the lowest was for the FA measurements of the corpus callosum - 51%. Highest sensitivity and specificity when discriminating patients MCI vs early AD was achieved with the volumetric measurement of the corpus callosum - these are 73% and 71% and the correct classification rate was 72%. Highest sensitivity and specificity when discriminating HC and patients with early AD was achieved with the volumetric measurement of the entorhinal cortex - these are 94% and 100% and the correct classification rate was 97%. Highest sensitivity and specificity when discriminating HC and patients with MCI was achieved with the volumetric measurement of the temporal lobe cortex - these are 90% and 93% and the correct classification rate was 92%.

## CONCLUSION

Diagnostic value varied depending on the measurement technique. Volumetric measurements proved to be the strongest imaging biomarker which allowed distinction between groups of patients. Corpus callosum volume assessment proved to be useful tool in discriminating patients MCI vs early AD.

## CLINICAL RELEVANCE/APPLICATION

By evaluation of the two measurement methods authors wanted to find the best imaging technique, which would help clinicians to evaluate patients and make the correct diagnosis.

### SSQ17-08 Heritability of Brain Atrophy on MRI in Advanced Age: A Twin Study of Healthy Middle-aged to Elderly Japanese Adults

Thursday, Dec. 3 11:40AM - 11:50AM Location: N229

#### Participants

Matthew W. Lukies, MBBS, Osaka, Japan (*Presenter*) Nothing to Disclose  
Yoshiyuki Watanabe, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Soshiro Ogata, Osaka, Japan (*Abstract Co-Author*) Nothing to Disclose  
Kayako Omura, Osaka, Japan (*Abstract Co-Author*) Nothing to Disclose  
Noriyuki Tomiyama, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Brain atrophy, a common finding on MRI, is part of the aging process and neurodegenerative diseases. The purpose of this study was to determine the heritability of brain atrophy and volume in advanced age using classical twin analyses of healthy Japanese middle-aged to elderly adult twin volunteers.

#### METHOD AND MATERIALS

74 individuals, 20 monozygotic (MZ) twin pairs (10MM 10FF, mean age 61y min 42y max 75y) and 17 dizygotic (DZ) twin pairs (8MM 8FF 1MF, mean age 64y min 41y max 85y), were selected with advanced age and gender match from the Osaka University Center for Twin Research registry. 3D T1 volume images from 3.0T MRI were used to measure volumes (L) for white matter (WM), grey matter (GM), cerebrospinal fluid (CSF) and total brain volume (TBV calculated as WM + GM) with statistical parametric mapping (SPM) 12 (University College London). Volume differences, correlations, twin modelling and heritability estimates (H2), controlled for age and gender, were performed using statistical platform R (v3.1.2) with OpenMx (v2.0.1).

#### RESULTS

The one male-female DZ twin pair was excluded due to significant difference in mean TBV based on gender (Welch two sample t-test  $p=0.027$ ). For all twins together, TBV (coefficient  $-0.450$ ,  $p<0.01$ ) and GM ( $-0.528$ ,  $p<0.01$ ) negatively correlated with age, where as CSF ( $0.646$ ,  $p<0.01$ ) positively correlated with age and WM ( $-0.055$ ,  $p=0.64$ ) was not significant. The differences in volume measurements between monozygotic twin pairs were significantly smaller than those for dizygotic twin pairs (T-TEST: TBV  $p<0.01$ , GM  $p<0.01$ , WM  $p<0.01$ , CSF  $p=0.03$ ). Heritability (H2) estimates on AE (additive genetics / unique environment) models for TV, GM and WM were 92.73%, 93.39% and 87.12% respectively. AE models were selected based on Akaike information criterion (AIC) for best fit and simplicity in twin studies. CSF best fit with a CE (common environment / unique environment) model, implying a stronger correlation with age and/or gender rather than heritance.

## CONCLUSION

Brain volume and atrophy have strong heritability of around 90% into advanced age, as demonstrated in this Japanese twin population. Further analysis of heritability of atrophy in specific brain locations is planned.

## CLINICAL RELEVANCE/APPLICATION

Atrophy is a common finding on MRI of adult and elderly brains. It is important to consider the strong heritability of brain volume when making associations with disease.

### SSQ17-09 Integrative Bayesian Analysis of Neuroimaging-Genetic Data with Application to Cocaine Dependence

Thursday, Dec. 3 11:50AM - 12:00PM Location: N229

#### Participants

Shabnam Azadeh, Houston, TX (*Presenter*) Nothing to Disclose  
Brian Hobbs, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Liangsuo Ma, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose  
David A. Nielsen, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
F. Gerard Moeller, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose  
Veera Baladandayuthapani, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To explore the underlying neurobiology of white matter integrity of cocaine-dependent subjects by integrative neuroimaging-genetic analysis of diffusion tensor imaging (DTI) and genetic, demographic and clinical features.

#### METHOD AND MATERIALS

We propose a novel computationally efficient method called integrative Bayesian analysis of neuroimaging-genetic (iBANG) to analyze large-scale imaging-genetics data. The iBANG methods uses a three-step component-wise analysis pipeline (i) estimate the association between each genetic and demographic variable via voxel-based Bayesian model averaging and obtain posterior probability maps (PPMs), (ii) incorporate spatial information pertaining to voxel locations to smooth the PPMs, and (iii): use Bayesian false discovery rates to delineate regions of brain activation while controlling for multiple testing. Our methods are motivated by and applied to a retrospective study in cocaine addiction where voxel-wise fractional anisotropy (FA) values were acquired over the white matter space spanning the entire brain in addition to twenty-one candidate SNPs known to be previously associated with addiction.

## **RESULTS**

Our study suggests that the impact of GAD1a (rs1978340) and GAD1b (rs769390) SNPs on FA values of the white matter of the brain was extensive in comparison to the other SNPs using iBANG. Significantly a total of 5217 voxel locations associated with GAD1a and the total number of 1332 voxel locations associated with GAD1b were found. Both GAD1a and GAD1b SNPs are associated with synthesis of GABA which plays a critical role in drug-reward and drug seeking behavior. Figure 1 depicts the multi-slice sagittal views of the neuroanatomic locations of significant regions in the white matter of the brain that were impacted by GAD1a. FA values on the white matter of the brain were significantly impacted by cocaine abuse to the extent of 3100 voxels.

## **CONCLUSION**

GAD1a and GAD1b SNPs are associated with synthesis of GABA led to FA enhancement in the most regions of the John Hopkins University (JHU) white matter atlas. Cocaine consumption caused FA diminishment in the most regions of the JHU white matter atlas.

## **CLINICAL RELEVANCE/APPLICATION**

Cocaine abuse and some of the candidate SNPs, GAD1a and GAD1b, show noticeable impact on FA alteration of white matter which cause changes on white matter integrity of the brain.

SSQ22

## Vascular/Interventional (Concepts in Aortic Aneurysm Interventions)

Thursday, Dec. 3 10:30AM - 12:00PM Location: N227



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

**FDA** Discussions may include off-label uses.

### Participants

Parag J. Patel, MD, Milwaukee, WI (*Moderator*) Consultant, Medtronic, Inc; Consultant, C. R. Bard, Inc; Consultant, Penumbra, Inc;  
Anisha S. Martin, MD, Chicago, IL (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ22-01 Is Contrast Enhanced Ultrasound the Endograft Imaging Modality of the Future?

Thursday, Dec. 3 10:30AM - 10:40AM Location: N227

### Participants

Rayshelle Finch, Orange, Australia (*Presenter*) Nothing to Disclose  
Steven Dubenec, Camperdown, Australia (*Abstract Co-Author*) Nothing to Disclose  
Sharyn Pussell, MBBS, Orange, Australia (*Abstract Co-Author*) Nothing to Disclose  
Bryan Khoury, FRANZCR, Orange, Australia (*Abstract Co-Author*) Nothing to Disclose  
Karen Pollard, Wagga Wagga, Australia (*Abstract Co-Author*) Nothing to Disclose  
Kenneth Russell, BA, Wagga Wagga, Australia (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

The aim of this study was to evaluate the clinical effectiveness of Contrast Enhanced Ultrasound (CEUS) in detecting the presence of endoleaks after Endovascular Aortic Aneurysm Repair (EVAR) and to compare the diagnostic accuracy with other imaging modalities.

### METHOD AND MATERIALS

One hundred and seven patients, all post EVAR, underwent surveillance utilising CEUS, CDU and CTA. Each modality assessed for the presence of an endoleak. The presence of contrast within the stent graft established patency and contrast within the residual aneurysm sac indicated the presence of an endoleak. Endoleaks were classified by type, origin and size. Quantitative comparison was made between each modality.

### RESULTS

There is a statistically significant increased rate of endoleak detection, especially for low amplitude, slow flowing endoleaks using CEUS in comparison to CDU and CTA. Two-tailed P value was calculated with McNemar's Test and continuity correction at <.0001. CDU identified thirty-six endoleaks, CTA identified thirty-nine endoleaks and CEUS identified sixty-three endoleaks. Statistical analysis has also highlighted that CDU in comparison to CTA in the detection of Endoleaks is not statistically significant. The two-tailed P Value equals 0.6625. These two imaging modalities were considered to be equivalent.

### CONCLUSION

In this prospective study, CEUS has proven to be an extremely effective imaging modality in the detection, visualisation and classification of endoleaks in comparison to CDU and CTA. CEUS is a sensitive adjunct to unenhanced ultrasound and is an extremely useful imaging modality in patients where CTA is contraindicated. CEUS is an accurate and minimally invasive way to interrogate these endografts and has in this study, demonstrated statistically significant improvements in the detection of endoleaks. If the advances in ultrasound imaging technology, with the use of contrast agents, continue to demonstrate its dominance, we believe CEUS will become a routine part of EVAR surveillance.

### CLINICAL RELEVANCE/APPLICATION

CEUS has a significant role to play in EVAR surveillance. It is an accurate and minimally invasive way to interrogate endografts and has demonstrated statistically significant improvements in endoleak detection.

#### SSQ22-02 Endoleak and Thrombus Characterization with Dynamic Elastography after Endoleak Embolization Following Aneurysm Endovascular Repair

Thursday, Dec. 3 10:40AM - 10:50AM Location: N227

### Awards

#### Trainee Research Prize - Medical Student

### Participants

Antony Bertrand-Grenier, Montreal, QC (*Presenter*) Nothing to Disclose  
Fateme Zehabi, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Helene Heon, DVM, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Guy Cloutier, PhD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Sophie Lerouge, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Gilles P. Soulez, MD, Montreal, QC (*Abstract Co-Author*) 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

### PURPOSE

SuperSonic Imagine ( SSI ) measure the tissue elasticity in real-time. The goal of this study was to characterize in a canine model

Supersonic imaging ( SSI ) measure the tissue elasticity in real time. The goal of this study was to characterize in a canine model of aneurysm endovascular repair ( EVAR ) residual endoleak and thrombus organization with SSI after endoleak embolization and correlate results with CT-Scan, Doppler Ultrasound ( DUS ) and pathologic findings.

#### **METHOD AND MATERIALS**

EVAR was done with creation of type I endoleak in eighteen aneurysms created in nine dogs (common iliacs arteries). Two embolization gels (Chitosan (Chi) or Chitosan-Sodium-Tetradecyl-Sulfate (Chi-STS)) were injected in the sac to seal the endoleak and promote healing. SSI and DUS were performed at baseline (implantation, 1-week, 1-month, 3-months) whereas angiography and CT-scan were performed at sacrifice. Macroscopic and histopathological analyses were processed to identify and segment five different regions of interest (ROIs) (endoleak, fresh or organized thrombus, Chi or Chi-STS). Elasticity modulus values were compared.

#### **RESULTS**

At sacrifice, 10 aneurysms had endoleaks, 9 had fresh thrombus, 15 had organized thrombus and 3 were completely sealed. At 3 months, elasticity modulus (in kPa) of  $0.1\pm 0.2$ ,  $9.4\pm 3.3$ ,  $47.6\pm 28.1$ ,  $51.7\pm 24.1$  and  $49.1\pm 33.5$  were respectively found in endoleak, fresh and organized thrombus, Chi and Chi-STS regions. Elasticity values of endoleak and fresh thrombus areas were significantly lower than organized thrombus, Chi and Chi-STS areas ( $p < 0.001$ ). Elasticity values of fresh thrombus ranged between 3 and 19 kPa ( $8.7\pm 3.6$  kPa) at 1-week and  $30.2\pm 13.8$  kPa at 3-months indicating that SSI can evaluate thrombus maturation. It can also characterize embolization agents degradation ( $39.3\pm 21.1$  and  $30.5\pm 13.8$  kPa at 6-months for Chi and Chi-STS regions). SSI was able to detect endoleak where DUS failed and distinguish fresh thrombus (possibly endotension) which cannot be detected on CT-scan.

#### **CONCLUSION**

The results confirm that SSI was able to evaluate thrombus organization and embolization agents over time after endoleak embolization following EVAR. A lower elastic modulus value corresponds to fresh thrombus whereas a higher value corresponds to organized thrombus.

#### **CLINICAL RELEVANCE/APPLICATION**

The SSI can complement conventional DUS in post-EVAR surveillance. It could reduce the cost, the exposition to ionizing radiation and nephrotoxic contrast agents of surveillance CT-scan follow-up.

#### **SSQ22-03 Incidence and Clinical Significance of Renal Infarct after Fenestrated Endovascular Aortic Repair**

Thursday, Dec. 3 10:50AM - 11:00AM Location: N227

#### **Participants**

Lauren M. Burke, MD, Chapel Hill, NC (*Abstract Co-Author*) Consultant, Amgen Inc  
Jesse M. Conyers, BS, Carrboro, NC (*Abstract Co-Author*) Nothing to Disclose  
Charles T. Burke, MD, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose  
Hyeon Yu, MD, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose  
Mark Farber, MD, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose  
Raghu Vallabhaneni, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose  
Ari J. Isaacson, MD, Chapel Hill, NC (*Abstract Co-Author*) Advisory Board, BTG International Ltd  
Robert G. Dixon, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose

#### **PURPOSE**

Renal infarcts are occasionally seen on post-fenestrated endovascular aortic repair (FEVAR) imaging. They can occur as a result of intentional exclusion of an accessory renal artery or after inadvertent embolism during the procedure. While the incidence of renal infarct following FEVAR is variable, the clinical significance of these renal infarcts is undocumented. The purpose of this study is to determine the incidence of renal infarcts on post-FEVAR imaging and what percentage of this subset of patients developed a subsequent increase in serum creatinine.

#### **METHOD AND MATERIALS**

All patients who underwent FEVAR at our institution between April 1, 2010 and April 1, 2014 and had pre- and post- contrast-enhanced CT were retrospectively identified and included for analysis. Two staff radiologists reviewed pre- and post-FEVAR CTs for the presence of renal infarcts. All post-FEVAR scans were obtained at least one month following FEVAR. The electronic medical record was used to record serum creatinine (Cr) values obtained concurrently with the pre- and post- scans as well as the need for hemodialysis following FEVAR. Incidence of renal infarct was calculated as well as the percentage of patients with post-FEVAR renal infarcts who had a significant rise in serum Cr (defined as a 0.3 mg/dl increase).

#### **RESULTS**

100 patients were included for analysis. 24 of these patients (24%) had a renal infarct identified on post-FEVAR CT. Of these, 10 (42%) were a result of purposeful covering of an accessory renal artery and 14 (58%) were embolic. Of the 14, only 3 (21%) had an increase in serum Cr of greater than 0.3 mg/dl during the post-FEVAR period (range 0.72-2.62, average 1.42). Of the 10 patients with renal infarct following covering of an accessory renal artery, only 1 (10%) demonstrated an increase in serum Cr (0.82). No patients in either group required temporary or permanent hemodialysis.

#### **CONCLUSION**

The presence of renal infarcts after FEVAR is not uncommon and often secondary to intentional exclusion of accessory renal vessels. The clinical relevance of these events appears relatively benign with only 17% of patients with renal infarcts demonstrating any significant decline in renal function, none of which required temporary or permanent dialysis in the short-term.

#### **CLINICAL RELEVANCE/APPLICATION**

Understanding the incidence and significance of renal infarct after FEVAR will improve communication between the radiologist and surgeon.

#### **SSQ22-04 eGFR Changes after Endovascular Treatment of Complex Aortic Aneurysms**

#### Participants

Anna M. Sailer, MD, MBA, Maastricht, Netherlands (*Presenter*) Nothing to Disclose  
Patty Nelemans, Maastricht, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Camille van Berlo, Maastricht, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Michiel W. De Haan, MD, PhD, Maastricht, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Dominik Fleischmann, MD, Palo Alto, CA (*Abstract Co-Author*) Research support, Siemens AG;  
Geert Willem H. Schurink, MD, PhD, Maastricht, Netherlands (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Endovascular repair of aortic aneurysms (EVAR) with complex anatomy (juxta-, suprarenal and thoracoabdominal aneurysms) has become feasible with novel fenestrated and branched devices. The risk of procedure related acute kidney injury (AKI), and subsequent permanent decrease of renal function is unknown. The aim of this study was to evaluate predictors for estimated glomerular filtration rate (eGFR) changes after fenestrated and branched EVAR with special interest in effect of intra-arterial iodinated contrast volume on risk of AKI and effect of AKI on long-term eGFR decrease.

#### METHOD AND MATERIALS

157 consecutive patients who underwent fenestrated and branched EVAR were included. Procedural intra-arterial iodinated contrast volume (iaIC; low-osmolar, 300 mg iodine/mL), serum creatinine levels at baseline, during 48 hours following EVAR, at discharge and latest follow-up (IFU) were recorded. eGFR was calculated using the Modification of Diet in Renal Disease formula. Development of post-EVAR AKI (according to AKIN criteria), coverage of accessory renal arteries during EVAR, patients' age, presence of diabetes and other risk factors were documented. Multivariate Cox proportional hazard models were used to identify independent risk factors for eGFR decrease during follow-up.

#### RESULTS

Forty-three patients (27%) developed post-EVAR AKI. Mean procedural iaIC volume in patients who developed AKI was 195 ±88 ml versus 149 ±69 ml in patients without AKI ( $p=0.001$ ). Median stay until discharge was 6 days (interquartile range (IQR) 3-9 days) and median time until latest FU was 380 days (IQR 117-925 days). Occlusion of accessory renal arteries and development of AKI were associated with a significantly increased risk for eGFR decrease at discharge (Hazard Ratio (HR) 3.19, 95%CI: 1.36 - 7.51;  $p=0.008$  and HR 2.87, 95%CI: 1.34 - 6.14;  $p<0.007$ ). There was also a significant association between AKI and eGFR decrease at IFU (HR 2.79, 95%CI: 1.44 - 5.39,  $p=0.002$ ). Iodinated contrast volume was not associated with eGFR decrease neither at discharge nor at IFU (HR 0.998;  $p=0.463$  and HR 1.000;  $p=0.857$ , respectively).

#### CONCLUSION

Post-EVAR AKI is significantly associated with short- and long-term eGFR decrease.

#### CLINICAL RELEVANCE/APPLICATION

Higher intra-arterial iodinated contrast volume is associated with higher probability of AKI, but the data provide no evidence that iodinated contrast volume is an independent risk factor for long-term eGFR decrease.

#### SSQ22-05 Type II Endoleak Proposed New Sub-Categorisation

#### Participants

Rayshelle Finch, Orange, Australia (*Presenter*) Nothing to Disclose  
Steven Dubenec, Camperdown, Australia (*Abstract Co-Author*) Nothing to Disclose  
Bryan Khoury, FRANZCR, Orange, Australia (*Abstract Co-Author*) Nothing to Disclose  
Sharyn Pussell, MBBS, Orange, Australia (*Abstract Co-Author*) Nothing to Disclose  
Karen Pollard, Wagga Wagga, Australia (*Abstract Co-Author*) Nothing to Disclose  
Ian Garbett, BS,MSc, Wagga Wagga, Australia (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The aim of this study was to evaluate the behaviour of Type II endoleaks utilising CEUS to aid visualisation and to determine the endoleak origin and communication with branch vessels.

#### METHOD AND MATERIALS

This observational study enrolled one hundred and seven patients who had undergone EVAR as treatment for their AAA. All patients underwent surveillance utilising CDUS, CEUS and CTA to assess for presence/absence of an endoleak. Contrast enhancement within the residual aneurysm sac indicated the presence of an endoleak. Endoleaks were classified by type, origin and size. Type II endoleaks were further subcategorised according to vessel behaviour, origin, communications and duplex Doppler characteristics.

#### RESULTS

Type II endoleaks were identified and subcategorised based on vessel origin, behaviour, channel connection and spectral Doppler characterization. We added Doppler information to Type II subcategories A and B. We distinguished two variants in subcategory IIB (i) and (ii) based on their communications and devised two further Type II subcategories C and D. Type IIC endoleaks were identified as the endoleak that may cause potential pressurisation to the residual aneurysm and were thought to be the most likely to cause risk to the patient, requiring intervention. All patients with this new endoleak subcategory were noted to have had an increase in sac size of  $\geq 5$ mm over a 6month period. The haemodynamic effect of this endoleak subtype was thought to be significant.

#### CONCLUSION

CEUS has a significant role to play in EVAR routine surveillance and is a sensitive adjunct to unenhanced ultrasound in the detection of endoleaks. The type and size of an endoleak and the residual sac size are the most important factors that influence the need for secondary intervention. Our additional sub-categorisations of Type II B (i) and (ii), C and D has shown initial benefit in determining an 'at risk' Type II endoleak. An enhanced understanding of Type II endoleaks will aid in future interventional and implementation

strategies, which will ultimately lead to EVAR success.

#### CLINICAL RELEVANCE/APPLICATION

This study identifies and subcategorises Type II-endoleak behaviour. Additional subcategorisation has shown initial benefit, extrapolating 'benign' and 'at risk' endoleaks. CEUS is a sensitive adjunct to CDU and CTA.

#### SSQ22-06 Integrated Stent-graft for Wireless 4-dimensional Aneurysm Sac Pressure Monitoring after Endovascular Aortic Aneurysm Repair (EVAR): First in Vitro Results

Thursday, Dec. 3 11:20AM - 11:30AM Location: N227

##### Participants

Clemens Spink, Hamburg, Germany (*Presenter*) Nothing to Disclose  
Bibin John, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Wolfgang H. Krautschneider, PhD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Dietmar Schroeder, PhD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Robert Fischbach, Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose  
Markus Braunschweig, Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose  
Jan-Hendrik Buhk, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Andreas Koops, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

##### PURPOSE

In vitro testing of prototype stent-grafts with an integrated array of nano-electronic pressure sensors within the stent-covering, capable of wireless digital data transmission for non-invasive 4-dimensional aneurysm sac pressure monitoring following EVAR.

##### METHOD AND MATERIALS

30 prototype stent-grafts were designed (85 mm x 16 mm), each containing 16 pressure sensors (1.5 mm x 1 mm x 1 mm) within the covering membrane of polytetrafluorethylene (PTFE). The prototypes were mounted on a 26 F delivery sheath and mono-iliacal placed into an aortic bifurcation model. Measurements were continuously taken from the sensors while inducing invasive reference pressure from the contralateral iliacal side. Digital data conversion was performed by an integrated microcontroller. Customised antenna technology was designed providing energy and data transfer by inductive coupling.

##### RESULTS

After successful placement of the stent-graft all 16 sensors delivered reliable pressure measurements continuously and could detect pressure-changes accurately up to  $\pm 1.2$  mmHg. Wireless energy and data transmission could be successfully demonstrated.

##### CONCLUSION

The non-invasive acquisition of pressure profiles along a stent-graft's membrane after EVAR can deliver information on regional pressure elevation, indicating early endoleak development. Our trials show practical and efficient ways of continuous aneurysm sac pressure monitoring in patients after EVAR. Further in vivo tests are required, developing an implementation into a product.

#### CLINICAL RELEVANCE/APPLICATION

Novel integrated 4-dimensional pressure monitoring may allow precise and early endoleak detection in patients after EVAR providing opportunities of telemetric data transmission.

#### SSQ22-07 Long Term Results after Endovascular Repair of Abdominal Aneurysm (EVAR): Impact of Hostile Neck Anatomy in Early and Long-term Complications and Aneurysm Related Death

Thursday, Dec. 3 11:30AM - 11:40AM Location: N227

##### Participants

Alvaro M. Morales Vargas, MD, Madrid, Spain (*Presenter*) Nothing to Disclose  
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Alvaro Fernandez Heredero, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
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Marta Gutierrez Mistal, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
Rosario Madero Jarabo, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

##### PURPOSE

To describe the impact of aneurysm neck morphology on complications and aneurysm-related death after EVAR.

##### METHOD AND MATERIALS

A cohort study of patients underwent elective EVAR in a tertiary institution between January 2002 and December 2013, prospectively collected and evaluated retrospectively. An angio-CT follow-up was performed before surgery and according to standards follow-up thereafter. Patients were classified as having hostile aortic necks (length of  $<10$  mm, angle of  $>50^\circ$ , diameter of  $>28$  mm, circumferential thrombus, calcified neck, and reverse taper), or favorable aortic necks. CT scans were reviewed by an experienced vascular radiologist. Outcomes are described according to reporting standards for endovascular aortic aneurysm repair EVAR. Statistical analysis. Time to event was estimated by the Kaplan-Meier method. 95% Confidence intervals were estimated. Risk Proportional Cox Models were used.

##### RESULTS

378 patients underwent EVAR. Demographics and co-morbidities were similar in hostile and favorable necks. 101 patients (26.7%) had hostile necks (34.7% angulated, 47.5% measured more than 28mm, 5% had circumferential thrombus, 16.8% had calcified neck and 9.9% had reversed taper) and 277 (73.3%) had favorable neck anatomy. Aorto-moniliac grafts were used in 79 hostile necks and bifurcated grafts in 22 of them. Overall technical success was 96.5%. Postoperative type-I endoleak occurred in 2.2% of hostile

necks, and was not present in favorable necks. Perioperative aneurysm-related mortality was 5% in hostile necks and 2.9% in favorable necks. Freedom of proximal type I endoleaks was 99.6% at 3 years and 99.4% at 12 years for favorable necks, compared to 92.1% at 3 years and 87.7% at 12 years in hostile neck anatomy. Primary clinical success rates were 97.1% at 1 year, and 85.4% at 12 years for favorable necks and 88.7% at 1 year and 65% at 12 years for hostile necks. 12-year overall mortality was 65.9% for favorable necks and 52 % for hostile necks. Cox Proportional-Hazards Model revealed that hostile necks and aorto-moniliac grafts increase significantly the risk of death or complications.

## CONCLUSION

Hostile aortic neck is associated with unfavorable early and long term results after endovascular repair of abdominal aneurysm, increasing the risk of complications and aneurysm-related death.

## CLINICAL RELEVANCE/APPLICATION

Hostile aortic neck increases long-term complications and aneurysm-related death after EVAR.

### SSQ22-08 Risk Factors of Stent Graft-Induced New Entry(SINE) after Thoracic Endovascular Aortic Repair(TEVAR) for Stanford Type B Aortic Dissection

Thursday, Dec. 3 11:40AM - 11:50AM Location: N227

#### Participants

Hyunsik Jang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
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Man Deuk Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jong Yun Won, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Sung Il Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Gyoung Min Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Stent graft-induced new entry (SINE) has been increasingly observed after thoracic endovascular aortic repair (TEVAR) for Stanford type B aortic dissection. SINE is often life threatening and re-intervention is required. The current study aims to investigate risk factors of SINE after TEVAR.

## METHOD AND MATERIALS

From July 2001 to June 2013, 79 patients who underwent TEVAR for Stanford type B aortic dissection were retrospectively analyzed. Mean age was 55.7 years (range, 25-84 years) and mean follow-up period was 53.5 months (range, 3days-130.2 months). 17 patients underwent TEVAR within 2 weeks (acute) after diagnosis of aortic dissection and the other 62 patients underwent TEVAR after 2 weeks (chronic). 42 patients underwent TEVAR with modified stent graft with 'inward bended' margin and the others used conventional stent graft. The longitudinal diameter, transverse diameter, mean diameter, area and circumference of true lumen were measured. Then taper ratio, pre-stent grafting oversizing ratio, post-stent grafting oversizing ratio, and expansion mismatch ratio of distal true lumen were calculated and compared between SINE group and non-SINE group.

## RESULTS

SINE occurred in 21 patients (26.5%). SINE occurred more frequently in chronic dissection group than acute dissection group (32.3% vs 5.9%,  $P = 0.032$ ). SINE event was not significantly different between modified and non-modified stent group (53.2% vs 46.8%,  $P = 0.615$ ). Taper ratio, pre-stent oversizing ratio and post-stent oversizing ratio were not significantly different in SINE and non-SINE group. Expansion mismatch ratio is significantly higher in SINE group than non-SINE groups in terms of longitudinal diameter (117.47 vs 104.44,  $P = 0.0041$ ), transverse diameter (147.00 vs 106.86,  $P < 0.0001$ ), mean diameter (137.46 vs 106.52,  $P < 0.0001$ ), area and circumference (136.72 vs 105.35,  $P = 0.0004$ ). 10 patients (47.6%) required re-intervention with surgery ( $n=4$ ) or stent-graft ( $n=6$ ).

## CONCLUSION

SINE after TEVAR was more frequent in chronic aortic dissection than acute dissection. Expansion mismatch ratio was significantly higher in SINE group than non-SINE group.

## CLINICAL RELEVANCE/APPLICATION

The time interval between diagnosis of aortic dissection and TEVAR is a factor predictive of late SINE event. SINE after TEVAR was more frequent in chronic aortic dissection than acute dissection.

### SSQ22-09 Diagnostic Accuracy of Axial Diameter Measurements for the Detection of Aneurysm Sac Enlargement after Endovascular Repair (EVAR) of Abdominal Aortic Aneurysms (AAA) by Computed Tomography (CT)

Thursday, Dec. 3 11:50AM - 12:00PM Location: N227

#### Participants

Michael Schnitzbauer, MSc, Berlin, Germany (*Presenter*) Nothing to Disclose  
Oliver Guntner, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Walter A. Wohlgemuth, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Michael Haimerl, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Florian Zeman, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Thomas Herold, MD, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose  
Christian R. Stroszczyński, MD, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Rene Muller-Wille, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate the diagnostic accuracy of diameter measurements for the detection of aneurysm volume increase during follow-up after endovascular aneurysm repair (EVAR) of abdominal aortic aneurysms (AAA).



## **METHOD AND MATERIALS**

We retrospectively analyzed 100 pairs of follow-up CT scans randomly picked from our EVAR database. The maximum aneurysm diameter was measured on axial planes (Dmax axial). The aneurysm sac volume was separately measured by manual segmentation (standard of reference).

## **RESULTS**

Using a cut-off level of  $> 0$  mm for diameter Dmax axial increased in 35 patients (mean 3.9 mm; range 1.0 to 31.0 mm). The aneurysm sac volume increased in 39 patients (mean, 25.7 cm<sup>3</sup>; range, 0.2 to 241 cm<sup>3</sup>). Dmax axial had a sensitivity/specificity of 74%/90%.

## **CONCLUSION**

Overall dependent on the chosen cut-off, diameter measurements showed a low to moderate diagnostic accuracy for the detection of aneurysm sac enlargement after EVAR.

## **CLINICAL RELEVANCE/APPLICATION**

Although broadly used in clinical practice diameter measurements seem to fail to detect size increase of the aneurysm sac during follow-up after EVAR.

SSQ16

## Neuroradiology (Advances in Neuro CT and MR Imaging)

Thursday, Dec. 3 10:30AM - 12:00PM Location: N228



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

**FDA** Discussions may include off-label uses.

### Participants

Mohannad Ibrahim, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose  
Rajan Jain, MD, Northville, MI (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ16-01 Ultra-Low and Standard Radiation Dose Head CT Scans Post-Processed with Model-Based Iterative Reconstruction (IR): Improved Image Quality / Artifact Reduction versus Adaptive Statistical IR and FBP

Thursday, Dec. 3 10:30AM - 10:40AM Location: N228

### Participants

Markus Y. Wu, MD, Boston, MA (*Presenter*) Nothing to Disclose  
Shervin Kamalian, MD, MSc, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Stuart R. Pomerantz, MD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company  
Michael H. Lev, MD, Boston, MA (*Abstract Co-Author*) Research support, General Electric Company Stockholder, General Electric Company

### PURPOSE

The purpose is to compare the image quality and artifact reduction of model-based iterative reconstruction (MBIR), adaptive statistical IR (ASIR), and filtered back projection (FBP), for post-processing both low and standard radiation dose head CT exams.

### METHOD AND MATERIALS

We compared 35 standard radiation-dose and 35 ultra-low dose unenhanced head, face and sinus CT studies from Feb-Mar 2015 on a 64-slice scanner, reconstructed at 0.625 and 5 mm slices using FBP, ASIR-90% blend, and MBIR-NR40. Gray-white matter (GM/WM) signal- and contrast-to-noise ratios (SNR, CNR) were computed from Hounsfield Unit measurements. Blinded visual ratings by an experienced neuroradiologist were performed for 15 cases from each group that had MRI reference-standard. Rated areas included: posterior fossa artifact/beam hardening, deep GM/WM matter differentiation, sharpness of aqueduct of Sylvius margins, and bleed/infarct (if present). Analysis of variance, T-test, and Kruskal-Wallis test were used.

### RESULTS

Mean CTDI radiation dose was  $10.6 \pm 5.2$  mGy for the ultra-low and  $40.1 \pm 12.9$  mGy for the standard-dose groups. Mean CNR for the low-dose group was  $1.1 \pm 0.4$  FBP,  $1.5 \pm 0.5$  ASIR, and  $2.5 \pm 0.6$  MBIR (all  $P < 0.001$ ). Mean CNR for the standard-dose group was  $1.5 \pm 0.4$  FBP,  $2.1 \pm 0.6$  ASIR, and  $2.6 \pm 0.6$  MBIR ( $P < 0.001$ ). All GM/WM-SNRs were similarly higher in exams processed with MBIR versus FBP or ASIR ( $P < 0.05$ ). Blinded qualitative review of all three rated areas in the low-dose group showed better image quality with MBIR ( $P < 0.05$ ). Standard-dose scans with MBIR had markedly better reduction of beam hardening effect and streak artifact in the posterior fossa versus ASIR and FBP ( $P < 0.001$ ). Of the 6 cases with MR-proven pathology in the standard-dose group, MBIR was superior or equal to ASIR in 5 cases (83%).

### CONCLUSION

Compared to FBP and ASIR, MBIR improves overall image quality in ultra-low dose head CT scans and markedly reduces beam hardening effect and streak artifact in the posterior fossa in standard-dose exams.

### CLINICAL RELEVANCE/APPLICATION

There is strong interest in lowering radiation dose while maintaining image quality and reducing artifact in clinical head CT scans. MBIR shows great potential in achieving this goal.

#### SSQ16-02 A Novel Tube Current Modulation Scheme in CT Perfusion Imaging to Reduce Radiation Dose and Improve Image Quality

Thursday, Dec. 3 10:40AM - 10:50AM Location: N228

### Participants

Ke Li, PhD, Madison, WI (*Presenter*) Nothing to Disclose  
Kai Niu, MS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Pengfei Yang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Beverly A. Kienitz, MD, DDS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Howard A. Rowley, MD, Madison, WI (*Abstract Co-Author*) Research Consultant, Bracco Group; Research Consultant, Guerbet SA; Research Consultant, General Electric Company; Consultant, F. Hoffmann-La Roche Ltd; Consultant, W.L. Gore & Associates, Inc; Consultant, Lundbeck Group; ; ; ; ;  
Charles M. Strother, MD, Madison, WI (*Abstract Co-Author*) Research Consultant, Siemens AG Research support, Siemens AG License agreement, Siemens AG  
Guang-Hong Chen, PhD, Madison, WI (*Abstract Co-Author*) Research funded, General Electric Company; Research funded, Siemens AG

### PURPOSE

Despite the relatively high radiation dose used in CT perfusion (CTP), the quality of CTP maps is not always great. It is critical to develop methods to simultaneously reduce radiation dose and further improve image quality. The purpose of this work is to demonstrate that the use of a new tube current modulation scheme and iterative image reconstruction algorithm can achieve a factor of five radiation dose reduction with improved CTP maps.

## METHOD AND MATERIALS

The limiting factors to the CTP maps were identified using a newly developed four-dimensional imaging chain model. This model enabled a fundamental understanding of how bias and noise were generated, amplified, and propagated to the final functional maps. As a result, the baseline image noise was discovered to be the primary factor impacting final CTP image quality. Once this limiting factor was identified, a novel tube current modulation scheme was developed to increase the mAs level for the baseline image acquisition to reduce noise, while lowering the exposure level and applying iterative reconstruction for the remaining acquisitions. The net result of this mA modulation scheme was a total radiation dose reduction by a factor of five. The proposed method was validated through an IACUC-approved in vivo canine stroke model. An additional CTP dataset acquired at high exposure level (300%) was used as the reference for image quality and quantitative accuracy, with which CTP maps acquired at both standard and reduced doses (20%) were compared.

## RESULTS

In addition to the factor of five dose reduction with the proposed tube current modulation scheme, the canine CTP maps demonstrated significant reduction in both bias and noise. The 20% dose dataset demonstrated only 10% bias and 14% relative increase in noise compared with the 300% dose reference dataset. In comparison, the conventional CTP technology generated 700% bias and 540% relative increase in noise at 20% dose.

## CONCLUSION

The proposed new tube current modulation scheme in conjunction with an iterative reconstruction algorithm enables a radiation dose reduction by a factor of five and improved quality in CTP maps.

## CLINICAL RELEVANCE/APPLICATION

The technique proposed here allows for lowering radiation dose while improving the quality of perfusion maps, both of which are crucial for patient selection for endovascular therapy of acute ischemic strokes.

### SSQ16-03 Low Dose CT Perfusion Using Projection View-Sharing

Thursday, Dec. 3 10:50AM - 11:00AM Location: N228

#### Participants

Thomas B. Martin, BS, Los Angeles, CA (*Presenter*) Nothing to Disclose

John M. Hoffman, BS, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

Michael F. McNitt-Gray, PhD, Los Angeles, CA (*Abstract Co-Author*) Institutional research agreement, Siemens AG; Research support, Siemens AG; ; ; ;

Danny J. Wang, PhD, Los Angeles, CA (*Abstract Co-Author*) Research Grant, Siemens AG Research Grant, Biogen Idec Inc Shareholder, Translational MRI, LLC

#### PURPOSE

CT Perfusion (CTP) is widely used in clinical practice for the evaluation of cerebrovascular disorders such as acute ischemic stroke. However, CTP involves high radiation dose ( $\geq 200$ mGy) as the X-ray source remains continuously on during the scan. The purpose of this study is to present a novel low dose CTP technique using a projection view-sharing reconstruction algorithm originally developed for dynamic MRI - "k-space Weighted Image Contrast" (KWIC) - under substantially reduced dose conditions in both phantom and a clinical case.

## METHOD AND MATERIALS

A clinical CTP scan (45s, 1160 projections per turn, 1s/turn, CTDIvol 217 mGy) was retrospectively undersampled to correspond to 50% and 25% of the original dose. The data sets were reconstructed using filtered back projection (FBP) and KWIC, based on an angle bisection scheme. In KWIC, FFT was performed on each projection to form a "k-space" like CT data space. As a projection view-sharing technique, KWIC preserves undersampled CTP quality by proportionately increasing the number of encoded projections for more distant regions of "k-space". An FBP reconstruction was used as the fully sampled gold standard. The above procedures were also performed on a FORBILD head phantom, including reconstructions down to 12.5% of the original set of projections, containing simulated time-varying objects. A map of the relative cerebral blood volume (rCBV), and the time-to-peak (TTP) and the full width half-maximum (FWHM) of the dynamic values were computed to assess potential dispersions in the dynamic CTP signals between the image reconstructions.

## RESULTS

The rCBV map, TTP, and the FWHM for all of the KWIC CTP reconstructions were unaffected by the undersampling/dose reduction (down to 25% dose) compared to the fully sampled FBP reconstruction.

## CONCLUSION

This pilot study demonstrates that KWIC preserves image quality and perfusion metrics at a reduced number of projections and that the unique contrast weighting of KWIC could provide substantial dose-savings for perfusion CT scans.

## CLINICAL RELEVANCE/APPLICATION

This technique may substantially reduce dose to patients undergoing CTP exams; alternatively, patients could potentially have multiple low dose CTP exams to have their diseases monitored more regularly, which could improve patient outcome.

### SSQ16-04 Efficacy of Fine Focal Spot Scanning in CT Carotid Angiography

Thursday, Dec. 3 11:00AM - 11:10AM Location: N228

#### Participants

Kenneth K. Lau, MBBS, FRANZCR, Melbourne, Australia (*Presenter*) Nothing to Disclose  
Lawrence Chia Wei Oh, MBBS, Melbourne, Australia (*Abstract Co-Author*) Nothing to Disclose  
Kevin Buchan, Melbourne, Australia (*Abstract Co-Author*) Employee, Koninklijke Philips NV  
Ahilan Kuganesan, Clayton, Australia (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

CT carotid angiography (CTCA) has been established as an important imaging tool for carotid artery assessment, in particular prior to surgical/radiological intervention. Its advantages in comparison to digital subtraction angiography (DSA) are shorter examination, non-invasive nature, less procedural complications and the ability to study soft tissue structure around the blood vessels. Calcified plaques are common at carotid bifurcations that produces beam-hardening artifact and often limits an accurate luminal assessment. The latest improvement of tube technology permits the use of fine focal spot (FFSS) in CTA that may provide better spatial resolution. The aim of this retrospective study was to assess the efficacy of FFSS in vessel wall clarity improvement and calcification artifact reduction on CTCA.

#### **METHOD AND MATERIALS**

Consecutive adult patients of all age and gender who presented for CTCA were included. Patients who did not give consent or whose images were markedly degraded by metal and motion artifacts were excluded. All CTCA were scanned with standard focal-spot size (SFSS) in initial 4 months while with FFSS in the following 4 months. Vessel clarity and calcifications artefacts of aortic arch, brachiocephalic, subclavian, common carotid, carotid bifurcation, internal carotid, external carotid and vertebral arteries were randomly and blindly assessed using 5-point scale by 2 blinded radiologists. Results were compared.

#### **RESULTS**

There were 43 patients (mean age of 60) with 97 calcified arterial segments in SFSS and 48 patients (mean age of 62) with 113 calcified arterial segments in FFSS. 30% patients have >50% carotid artery stenosis. Interobserver agreement was excellent ( $\kappa = .834$ ). Mann-Whitney test showed FFSS performed significantly better for vessel clarity (U: 48238.50,  $p < .001$ ,  $r: 0.556$ ) and calcification artefact reduction (U: 2040.50,  $p < .001$ ,  $r: 0.564$ ). The carotid bifurcation lumen were better defined in FFSS.

#### **CONCLUSION**

FFSS technique improves vessel clarity and reduces calcification blooming artefacts in CTCA which aids accurate assessment of vascular pathology.

#### **CLINICAL RELEVANCE/APPLICATION**

The lumen of the carotid bifurcation is often obscured by blooming artifacts from calcified plaques that may lead to misleading result. The FFSS scanning technique may become a future imaging tool to minimize this diagnostic difficulty and provide better plaque morphology assessment.

#### **SSQ16-06 Computer Automated Methods to Determine Brain Glioma Volume and Its Efficiency in Comparison to the Expert Estimation**

Thursday, Dec. 3 11:20AM - 11:30AM Location: N228

#### **Participants**

Seyedeh Shahrzad Azizadini, Saint Louis, MO (*Presenter*) Nothing to Disclose  
Mahsa Mohammadi Kaji, Karlsruhe, Germany (*Abstract Co-Author*) Nothing to Disclose  
Saeed Arefanian, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Shohreh Kasaei, Tehran, Iran (*Abstract Co-Author*) Nothing to Disclose  
Morteza Sanei Taheri, MD, Tehran, Iran (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

Tumor volume parameter is one of the most important prognostic factors in glioma. Determining the glioma tumor volume is a problematic task due to its irregularity in shape, involvement of different parts of brain and wide variety in contrast enhancement degrees. Objectives of the study were to design image processing-based software to determine the volume of glioma and evaluating its efficiency in comparison with radiologist estimation.

#### **METHOD AND MATERIALS**

The software was designed and calibrated based on 7 pathologically approved glioma patients. The software exploited enhancement regions in FLAIR and T1 Gadolinium contrast MRI using image segmentation technique to determine tumor volume, based on region growing of manually selected seed points. Consecutively, the volumes of brain glioma in 42 cases were estimated by an expert radiologist as well as the designed software and the data was analyzed for comparison.

#### **CONCLUSION**

Estimation of brain glioma volume with the designed software has the same accuracy as the expert estimation in a more time efficient manner. The main application restriction for the designed software is its limitation to well-enhanced regions after Gadolinium injection.

#### **CLINICAL RELEVANCE/APPLICATION**

Tumor volume is a main prognostic factor in brain glioma. Volume estimation by software via segmentation technique had the same accuracy as expert reading in a time efficient manner.

#### **SSQ16-07 Spectroscopic Imaging with High Spatial Resolution and Ultra Short TE\* at 3 and 7 Tesla- A Comparison**

Thursday, Dec. 3 11:30AM - 11:40AM Location: N228

#### **Participants**

Stephan Gruber, MD, Vienna, Austria (*Presenter*) Nothing to Disclose  
Eva Heckova, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

Lenka Minarikova, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Bernhard Strasser, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Gilbert Hangel, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Siegfried Trattinig, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Wolfgang Bogner, MSc, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Magnetic resonance spectroscopic imaging (MRSI) of the brain allows to map several metabolites and provide complementary metabolic information to the conventional MR imaging methods. High field systems (e.g. 7 T) offer increased SNR and spectral resolution which can be transformed to the increased spatial resolution or better characterization of overlapping metabolites (e.g. NAA and NAAG). In addition FID-CSI with ultra short acquisition delays ( $TE^*$ ) adds additional SNR, in particular for J-coupled resonances. We compared MRSI in six volunteers using a FID-CSI sequence with high spatial resolution and ultra-short  $TE^*$  of 1.5 ms at 3 and 7 Tesla.

## METHOD AND MATERIALS

Six healthy volunteers (5m/1f; age:  $28.3 \pm 2.4$ ) were measured at 3T and 7T (3T Trio, 7T Magnetom, Siemens, Erlangen, Germany) using a 32-channel head coil. A FID-CSI sequence with  $64 \times 64$  phase encoding steps,  $FOV = 220 \times 220 \text{ mm}^2$ ,  $TR = 600 \text{ ms}$ ,  $TE^* = 1.5 \text{ ms}$ , in plane voxel size  $3.4 \times 3.4 \text{ mm}^2$ , and a slice thickness of 10 mm was used (scan time 30min). Spectra were processed using LCMoDel. Metabolic maps were created using Matlab and MINC (Minc tools; v2.0; McConnell Brain Imaging Center, Montreal, Canada). SNRs were computed using the pseudo-replica method in time domain.

## RESULTS

Satisfactory data quality was achieved from all subjects measured at 3 T and 7 T. SNR was 2.8 times higher at 7 T compared to 3 T. CRLBs were below 10% for all metabolites measured at 7 T including glutamate and glutamine. Compared to techniques using pre-localization techniques (e.g. STEAM, PRESS) FID-CSI allows to acquire whole slices. The high matrix size and hamming filtering prevented fat contamination from the sculp. With the high in-plane resolution of  $3.4 \times 3.4 \text{ mm}^2$  metabolic maps showing anatomical details could be created.

## CONCLUSION

This study revealed 2.8 times higher SNR and decreased CRLBs of brain metabolites measured with MRSI at 7 T compared to that measured at 3T. We could compute metabolic maps with anatomical details at both field strengths. Improved spectral resolution allowed NAAG separation from NAA at 7 T but not at 3 T. In addition the ultra-short acquisition delay allows to quantify J-coupled metabolites even measured with a high spatial resolution.

## CLINICAL RELEVANCE/APPLICATION

MRSI at 7T can be performed with high spatial resolution and ultrashort  $TE^*$ . This allows the quantification of metabolites such as NAAG, glutamate, glutamine and myo-Inositol with low CRLBs.

## SSQ16-08 Optimized Clinical MRI Protocols for Ex Vivo Whole Brain - A New Tool for Radiology-Pathology Correlation

Thursday, Dec. 3 11:40AM - 11:50AM Location: N228

### Participants

Mary Bruno, RT, New York, NY (*Presenter*) Nothing to Disclose  
Ryan Brown, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Guillaume Madelin, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Pippa Storey, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Henry Rusinek, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Timothy M. Shepherd, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Autopsies with neuropathology protocols are used to investigate sudden, unexpected patient deaths, but it is difficult to obtain correlation to a clinical MRI of the brain because of nervous tissue MRI property changes linked to the postmortem interval, chemical fixation and temperature differences. We measured these changes, then adapted MRI sequence pulse parameters to re-create a robust clinical MRI protocol for ex vivo whole brain imaging.

## METHOD AND MATERIALS

Donated ex vivo whole brains immersion-fixed in formalin for 2 weeks were washed in phosphate-buffered saline for 8 weeks with repeated solution exchanges. Inversion recovery and multiecho sequences at 3-T MRI showed the  $T1/T2$  values of gray and white matter decreased to 267/73 and 168/43 ms respectively in formalin-fixed ex vivo whole brains. Multiple MRI sequences were adjusted iteratively for these relaxation changes based on spin dynamics theory to give consistent image contrast, resolution and quality compared to in vivo MRI protocols.

## RESULTS

Optimal MRI sequences at 3-T were different compared to standard in vivo MRI protocols - a) FLAIR:  $TR/TE/TI = 3000/45/1100 \text{ ms}$ ,  $0.5 \times 0.5 \times 2\text{-mm}$  resolution, b) TSE T2:  $TR/TE = 5000/76 \text{ ms}$ ,  $0.5 \times 0.5 \times 0.8\text{-mm}$  resolution, c) 3-D Gradient Echo:  $TR/TE = 20/10 \text{ ms}$  with 180 flip angle, 0.46-mm isotropic resolution, and d) Diffusion Tensor Imaging:  $TR/TE = 3500/90 \text{ ms}$ , b-values = 0, 1000 & 2000  $\text{s/mm}^2$  with 64 directions, 3-mm isotropic resolution. Decreased echo-train-length also reduced gray-white blurring. Volumetric 3-D image contrast is degraded by the short  $T1$ 's, but may be improved by a multi-segmented approach. The overall scan required <2 hrs overnight using an outpatient 3-T scanner and 64-channel coil.

## CONCLUSION

We successfully created a "clinical" MRI protocol for ex vivo brains with similar image quality and contrast to routine radiology protocols. This can be used for detailed radiology-pathology correlations in clinical cases of sudden death. The protocol also may help detect abnormalities in Sudden Unexplained Death in Epilepsy (SUDEP) or directly correlate MRI property changes with underlying Alzheimer's pathology.

## CLINICAL RELEVANCE/APPLICATION

We describe an ex vivo whole brain MRI protocol that recapitulates standard clinical protocols well to guide clinical or research radiology-pathology studies in a variety of patient populations.

## SSQ16-09 Amide Proton Transfer Imaging of Neonatal Brain Development and Brain Injury: A Preliminary Study

Thursday, Dec. 3 11:50AM - 12:00PM Location: N228

### Participants

Yang Zheng, Shenyang, China (*Presenter*) Nothing to Disclose

Xiaoming Wang, MD, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate neonatal brain development and injury at the internal environmental level with the application of amide proton transfer (APT) imaging by measuring the APT values of several part of the brain.

### METHOD AND MATERIALS

A total of 51 neonatal patients who underwent MR examination were enrolled in the study. Among them, there were 38 newborns with no abnormalities and 13 cases with brain injury who underwent conventional MR (T1WI, T2WI, DWI) examination. After obtaining informed consent and permission of clinicians, routine MR was followed by additional APT scan. APT imaging is single slice scanning, performed at the basal ganglia level in all neonates, and in the case group, with increased localization at the level of lesion, and with the contralateral relatively normal area as self-control. The APT values of bilateral frontal subcortical white matter, basal ganglia and occipital subcortical white matter were measured for all neonates, as well as the APT values of the lesion and contralateral areas. Several statistical methods were used for statistical analysis.

### RESULTS

In the control group, bilateral frontal subcortical white matter, basal ganglia and occipital subcortical white matter had no significant difference in APT value ( $P > 0.05$ ). Between the different parts of the brain, APT values were significantly different ( $P < 0.05$ ), and were associated with gestational age linear positive correlation. In the case group, there were significant differences in APT values between the lesion side and contralateral area, being significantly lower in lesion side than the contralateral side ( $P < 0.05$ ). In the case group, the APT values of different parts of the brain were lower than the control group with the same gestational age ( $P < 0.05$ ).

### CONCLUSION

From changes in the protein and pH level in the neonatal brain, APT imaging can help understand neonatal brain development and evaluate brain injury.

### CLINICAL RELEVANCE/APPLICATION

Amide proton transfer (APT) imaging is a noninvasive imaging method of MR, and it is capable of detecting mobile cellular proteins and peptides and monitoring pH effects.

SSQ04

## Chest (Pulmonary Nodule)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E351

**CH** **CT** **MR** **OI**

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

**FDA** Discussions may include off-label uses.

### Participants

Christian J. Herold, MD, Vienna, Austria (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ04-01 Pulmonary Thin-Section MR Imaging with Ultra-Short TE vs. Low- and Standard-Dose Thin-Section CTs: Capability for Lung Nodule Detection and Nodule Type Evaluation

Thursday, Dec. 3 10:30AM - 10:40AM Location: E351

### Participants

Yoshiharu Ohno, MD, PhD, Kobe, Japan (*Presenter*) Research Grant, Toshiba Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Terumo Corporation; Research Grant, Fuji Yakuin Co, Ltd; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Guerbet SA; Shinichiro Seki, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose  
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Kazuro Sugimura, MD, PhD, Kobe, Japan (*Abstract Co-Author*) Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

### PURPOSE

To compare the capability of pulmonary MR imaging with ultra-short echo time (UTE) for lung nodule detection and nodule type evaluation with thin-section low- and standard-dose CTs.

### METHOD AND MATERIALS

170 consecutive patients (96 males: mean age, 70 years and 74 females: mean age, 70 years) with suspected pulmonary nodules at near-by hospital were examined with chest standard- and low-dose CTs (270 mA [SDCT] and 50 mA [LDCT]) and pulmonary MR imaging with UTE. According to standard-dose CT findings, all nodules were divided into solid and part-solid nodules and ground glass nodules. In each patient, probability of presence at each pulmonary nodule was assessed on all three methods by means of 5-point visual scoring system. To determine inter-observer and inter-method agreement for nodule detection, kappa statistics with  $\chi^2$  test were performed. Then, ROC analyses were performed to compare detection capability among all methods. Finally, detection rate was compared each other by means of McNemar's test. To determine inter-observer and inter-method agreement for nodule type evaluation on each method, kappa statistics with  $\chi^2$  test were also performed.

### RESULTS

On nodule detection, inter-observer agreements on all methods ( $0.81 < \kappa < 0.85$ ,  $p < 0.0001$ ) and inter-method agreement among all methods ( $0.87 < \kappa < 0.96$ ,  $p < 0.0001$ ) were determined as almost perfect. Area under the curves (Azs) of all methods (SDCT: Az=0.97, LDCT: Az=0.96, MRI: Az=0.96) had no significant difference ( $p > 0.05$ ). In addition, detection rates of all three methods (SDCT: 92.0 [252/274] %, LDCT: 91.5 [247/270] %, and MRI: 91.5 [247/270] %) had also no significant difference ( $p > 0.05$ ). On nodule type assessment, inter-observer agreement of each method was almost perfect ( $0.87 < \kappa < 0.91$ ,  $p < 0.0001$ ). In addition, inter-method agreements among all methods were also determined as almost perfect ( $0.81 < \kappa < 0.89$ ,  $p < 0.0001$ ).

### CONCLUSION

Pulmonary MR imaging with UTE is considered at least as valuable as low- and standard-dose CTs for lung nodule detection and nodule type evaluation.

### CLINICAL RELEVANCE/APPLICATION

Pulmonary MR imaging with UTE is considered at least as valuable as low- and standard-dose CTs for lung nodule detection and nodule type evaluation.

#### SSQ04-02 Persistent Pulmonary Subsolid Nodules with Solid Parts of 5mm or Smaller: Their Natural Courses and Predictors for Interval Growth on Follow-ups

Thursday, Dec. 3 10:40AM - 10:50AM Location: E351

### Participants

Jong Hyuk Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
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Sang Min Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jin Mo Goo, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Research Grant, Guerbet SA;

## PURPOSE

To investigate the natural courses of persistent pulmonary subsolid nodules (SSNs) with solid parts  $\leq 5$ mm and the clinico-radiological predictors for their interval growth over follow-ups.

## METHOD AND MATERIALS

From 2005 to 2013, natural courses of 213 persistent SSNs detected on chest CT (slice thickness  $\leq 1.25$ mm) in 213 patients (mean age,  $57.88 \pm 10.38$  years; range, 24-87 years) were evaluated in this study (median follow-up, 849 days; range, 90-2900 days). To identify significant predictors for interval growth, Kaplan-Meier analysis and Cox proportional hazard regression analysis were performed.

## RESULTS

One-hundred thirty-six were pure ground-glass nodules (GGNs) (growth in 18; stable in 118) and 77 part-solid GGNs with solid parts  $\leq 5$ mm (growth in 24; stable in 53). For 213 SSNs, lung cancer history (Hazard ratio (HR), 3.884;  $p=0.001$ ), part-solid GGNs (HR, 3.570;  $p<0.001$ ), and nodule diameter (HR, 3.576;  $p<0.001$ ) were significant predictors for interval growth. In subgroup analysis, nodule diameter was an independent predictor for interval growth of both pure GGNs (HR, 6.620;  $p<0.001$ ), and part-solid GGNs (HR, 2.749;  $p=0.037$ ). For part-solid GGNs, lung cancer history (HR, 5.917;  $p=0.002$ ) was another significant predictor for interval growth. The frequency of interval growth of pure GGNs  $\geq 10$ mm (12.9%, 30.4%, 42.0%, 42.0%, 71.0% at 1, 2, 3, 4, 5 year's follow-up) and part-solid GGNs  $\geq 8$ mm (11.5%, 38.0%, 43.6%, 78.9%, 78.9%) was significantly higher than those of pure GGNs  $< 10$ mm (1.9%, 4.0%, 10.9%, 13.5%, 13.5%) ( $p<0.001$ ) and part-solid GGNs  $< 8$ mm (11.5%, 21.5%, 21.5%, 21.5%, 21.5%) ( $p=0.003$ ), respectively.

## CONCLUSION

Natural course of SSNs with solid parts  $\leq 5$ mm was significantly different regarding their nodule types and nodule diameters, with which their managements can be subdivided.

## CLINICAL RELEVANCE/APPLICATION

Nodule type and nodule diameter are significant predictors for interval growth of SSNs with solid parts  $\leq 5$ mm, and managements of SSNs with solid parts  $\leq 5$ mm can be categorized based on these predictors.

## SSQ04-03 Ground Glass Nodule Detectability in Seven observers of Seventy-nine Clinical Cases: Comparison between Ultra-Low-Dose Chest Digital Tomosynthesis with Iterative Reconstruction and Chest Radiography by Receiver-Operating Characteristics Analysis

Thursday, Dec. 3 10:50AM - 11:00AM Location: E351

### Participants

Yukihiro Nagatani, MD, Otsu, Japan (*Presenter*) Nothing to Disclose  
Masashi Takahashi, MD, Otsu, Japan (*Abstract Co-Author*) Nothing to Disclose  
Mitsuru Ikeda, MD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose  
Nori-hisa Nitta, MD, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose  
Katsunori Miyata, RT, Otsu, Japan (*Abstract Co-Author*) Nothing to Disclose  
Akinaga Sonoda, MD, PhD, Otsu, Japan (*Abstract Co-Author*) Nothing to Disclose  
Jun Hanaoka, Otsu, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yasutaka Nakano, MD, PhD, Otsu, Japan (*Abstract Co-Author*) Nothing to Disclose  
Noritoshi Ushio, RT, Otsu, Japan (*Abstract Co-Author*) Nothing to Disclose  
Kiyoshi Murata, MD, Otsu, Japan (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To compare ground glass nodules detectability (GGND) between ultra-low-dose chest digital tomosynthesis (ULD-CDT) with 2 different reconstruction algorithms and chest radiography (CR) by using low-dose computed tomography (LDCT) as the standard of reference (SOR).

## METHOD AND MATERIALS

The Institutional Review Board approved this study and written informed consent was obtained. In a single visit each, 79 subjects underwent ULD-CDT at 120kV and 10mA, CR both in posterior-anterior and lateral direction and LDCT (effective dose: 0.081, 0.117 and 3.52 mSv, respectively). In each of 79 cases, 63 reconstructed coronal images were obtained using CDT (SONIALVISION Safire 17 radiography/fluoroscopy system, Shimadzu, Kyoto, Japan) with and without iterative reconstruction (IR). SOR as to GGN presence with the longest diameter (LD) of 3mm or more was determined based on LDCT images by consensus reading of two radiologists. Another seven radiologists independently recorded GGN presence and their locations by continuously-distributed rating. Receiver-operating characteristic (ROC) analysis and detection sensitivity (DS) was used to compare GGND of ULD-CDT with IR, ULD-CDT without IR and CR in total and subgroups classified by nodular LD ( $>$  or  $<$  9mm) and CT attenuation value (CTAV) ( $>$  or  $<$  600 Hounsfield of Unit (HU)). DS were also compared between any pairs of 4 sub-groups in each of three modalities using t-test.

## RESULTS

For SOR, 105 GGNs were identified. The minimal and maximal LDs of GGN were 3.0 and 26 mm, respectively, with a mean LD of 8.56 mm. In total as well as any sub-group, GGND at ULD-CDT with IR was higher than either that at ULD-CDT without IR or CR, as area under ROC curve was  $0.66 \pm 0.02$ ,  $0.59 \pm 0.01$  and  $0.52 \pm 0.01$ , respectively ( $p < 0.05$ ). DS at ULD-CDT with IR in more attenuated GGNs (CTAV  $>$ -600 HU) was higher than that in less attenuated GGNs ( $47.5 \pm 8.1\%$  vs  $26.6 \pm 6.7\%$ ) ( $p < 0.05$ ). DS at ULD-CDT with IR in larger GGNs (LD  $>$  9mm) was higher than that in smaller GGNs ( $44.6 \pm 7.7\%$  vs  $22.1 \pm 5.4\%$ ) ( $p < 0.05$ ).

## CONCLUSION

ULD-CDT with IR demonstrated better GGND than that without IR or CR, with increased DS for larger or more attenuated GGNs.

## CLINICAL RELEVANCE/APPLICATION

ULD-CDT with IR has a potential to be used for detection of larger and more attenuated GGN.



## **SSQ04-04 Participants Hold Lung MR Imaging for Nodule Detection: Combination of 3D mDixon and Black-blood Fat-saturated HASTE Sequences**

Thursday, Dec. 3 11:00AM - 11:10AM Location: E351

Ryotaro Kamei, MD, Fukuoka, Japan (*Presenter*) Nothing to Disclose  
Yuji Watanabe, MD, Fukuoka, Japan (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV Research Grant, Bayer AG  
Koji Sagiya, MD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose  
Satoshi Kawanami, MD, Fukuoka, Japan (*Abstract Co-Author*) Research Grant, Bayer AG; Research Grant, Koninklijke Philips NV  
Hiroshi Honda, MD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose

### **PURPOSE**

To compare the diagnostic performance of breath-hold lung MR imaging as a part of whole-body PET/MR hybrid imaging with that of low-dose CT from PET/CT in the detection of nodular lesions.

### **METHOD AND MATERIALS**

We included 21 consecutive patients who underwent diagnostic CT, PET/CT, and MR of the whole lung from August 2014 to March 2015. MR images were acquired using Ingenia 3.0T MR (Philips) or the 3.0T MR part of Ingenuity TF PET/MR (Philips). The MR protocol consisted of T1-weighted image (T1WI) with 3D modified Dixon (mDixon) sequence, and black-blood fat-saturated T2-weighted image (FS-T2WI) with Half-Fourier Acquisition Single-shot Turbo Spin-echo (HASTE) sequence. Both were performed with breath-hold, and the mean scan duration was 21.2 s for T1WI and 14.5 s (two stations) for FS-T2WI. Low-dose CT was performed under free breathing. Diagnostic CT images were used as the reference standard. The location, number, size, and characterization (solid, pure, or mixed ground-glass opacity [GGOs]) of nodular lesions were recorded. Two radiologists reviewed the MR and CT images from PET/CT in consensus, with an interval of one week. Lesion-based sensitivity and lung lobe-based specificity were calculated. Statistical analyses were performed with McNemar test and Wilcoxon signed-rank test.

### **RESULTS**

Overall sensitivity and specificity were 64.6% (31/48) and 96.9% (62/64) for MR, and 77.1% (37/48) and 82.8% (53/64) for low-dose CT, respectively. On the MR images, 76.9% (30/39) of nodules measuring  $\geq 5$  mm were pointed out, while only 11.1% (1/9) of nodules  $< 5$  mm were detected. For nodules  $\geq 5$  mm, detection rates were 81.5% (22/27) for solid lesions and 66.7% (8/12) for GGOs. The size of solid lesions on the MR images did not differ significantly from the reference group. On the other hand, mixed GGOs tended to appear smaller on T1WI, and pure GGOs were only visible on T2WI.

### **CONCLUSION**

Breath-hold lung MR imaging with combined use of 3D mDixon T1WI and black blood FS-T2WI HASTE provides brief examination with acceptable diagnostic accuracy and could be feasible as a part of whole-body PET/MR hybrid imaging.

### **CLINICAL RELEVANCE/APPLICATION**

Breath-hold lung MR imaging has fair sensitivity and good specificity to detect nodular lesions. In addition to previously reported T1WI, FS-T2WI might be necessary to accurately depict GGOs.

## **SSQ04-05 Value of [18F]Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography in Patients with Persistent Pulmonary Part-Solid Nodules Detected at CT**

Thursday, Dec. 3 11:10AM - 11:20AM Location: E351

Participants  
Jihang Kim, MD, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Kyung Won Lee, MD, PhD, Seongnam, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### **PURPOSE**

Although current National Comprehensive Cancer Network guidelines suggest [18F]fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT) for the pretreatment evaluation of early stage non-small cell lung cancer, the role of FDG-PET/CT in patients with persistent pulmonary part-solid nodules is yet to be determined. The purpose of our study was to evaluate the incremental value of FDG-PET/CT in the pretreatment evaluation of non-small cell lung cancer detected as part-solid nodules at chest CT.

### **METHOD AND MATERIALS**

From March 2011 through March 2015, 164 consecutive patients who underwent whole-body FDG-PET/CT for the pretreatment evaluation of non-small cell carcinoma detected as pulmonary part-solid nodules at chest CT were included. We analyzed the chest CT and FDG-PET/CT reports prospectively made by board-certified radiologists and nuclear medicine physicians as a part of our standard practice. The CT, FDG-PET/CT and histopathologic characteristics of the nodules were demonstrated and the incremental value of FDG-PET/CT over chest CT in the nodal or extrathoracic staging was evaluated.

### **RESULTS**

For the pretreatment evaluation, FDG-PET/CT was performed in 164 patients with 181 part-solid pulmonary nodules (diameter;  $23.4 \pm 8.2$  mm, mean solid proportion; 67.8%). Among them, 156 patients with 172 nodules underwent subsequent surgical resection. All of the nodules were histopathologically confirmed as adenocarcinoma ( $n = 1, 91, 51$  and  $29$  for Tis, T1a, T1b, and T2a, respectively). In the retrospective analysis of prospective CT and FDG-PET/CT interpretations, only 4 and 3 patients were suspected to have lymph node metastases, respectively. In histopathologic confirmation, 5 of 156 patients had lymph node metastases and the maximum standardised uptake value of them varied from 1.2 to 6.1. The per-patient sensitivities of CT and FDG-PET/CT in detection of lymph node metastasis were 40% and 20%, respectively, and FDG-PET/CT showed no incremental value in nodal staging. While eight incidental extrathoracic malignancies were suspected at FDG-PET/CT, further diagnostic work-up revealed them as benign.

### **CONCLUSION**

FDG-PET/CT showed no incremental value in the pretreatment evaluation of non-small cell lung cancer detected as part-solid

nodules at chest CT.

#### CLINICAL RELEVANCE/APPLICATION

In the pretreatment evaluation of non-small cell lung cancer detected as part-solid nodules at chest CT, additional imaging study with FDG-PET/CT is not necessary.

#### SSQ04-06 Optimal Window Settings to Improve Visual Detection of Ground-glass Nodules (GGN) - Effect on Agreement and Time-to-detection

Thursday, Dec. 3 11:20AM - 11:30AM Location: E351

##### Participants

Julia Alegria, MD, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose

Claudio S. Silva Fuente-Alba, MD, MSc, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose

Daniela Barahona, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

##### PURPOSE

To assess different window settings for visual detection of ground glass nodules (GGN), regarding inter-reader agreement for localization and diameter, measurement bias and time-to-detection (TTD).

##### METHOD AND MATERIALS

IRB approved retrospective study. Chest CT dataset with 40 GGN and 10 sets with no detectable nodules, was designed. After de-identification, all datasets were presented to two thoracic radiologists (acting as reference standard) and a fellow, independently, in four different reading sessions two weeks apart from each other, using IMPAX PACS viewers. Only axial slices were analysed, no MPR or MIP reconstructions were allowed. The settings assessed were Lung Window (W 1500 UH, L -500 UH), Emphysema Window (W 800 UH, L -800 UH), Inverted Lung Window and Inverted Emphysema Window. Location, maximum diameter and TTD were recorded for each nodule. Interreader agreement for localization was analyzed with Cohen's Kappa statistics with 95% CI, diameters agreement with Lin's correlation-concordance coefficient Rho 95%CI with average bias assessed with Bland-Altman with 95% limits of agreement (LOM).

##### RESULTS

High agreement was identified in all settings with Kappa values for Lung Window (LW) 0.71 (0.53-0.78), Emphysema Window (EW) 0.72 (0.63-0.82), Inverted Lung Window (ILW) 0.71 (0.62-0.74) and Inverted Emphysema Window (IEW) 0.79 (0.73-0.88). Lin's Rho ranged from 0.85 (0.78-0.92) in LW, 0.80 (0.72-0.89) in EW, 0.89 (0.84-0.95) in ILW and 0.92 (0.88-0.96) in IEW. Bland-Altman analysis showed average bias in mm (LOM) of -0.64 (-4.19 to 2.9) in LW, -0.69 (-4.91 to 3.52) in EW, -0.29 (-3.75 to 3.17) in ILW and 0.09 (-2.83 to 3.02) in IEW. Average TTD ranged from 21.3 sec in LW to 58.1 sec in ILW, and was significantly higher in all settings in the fellow's readings versus thoracic radiologists' ( $p < 0.01$ ), with a reduced TTD for both groups only in IEW ( $p < 0.01$ ).

##### CONCLUSION

IEW provides a visual setting with high reader agreement, measurements concordance with low measurement bias, and reduced TTD for GGN detection.

#### CLINICAL RELEVANCE/APPLICATION

IEW could be used as a visual aid for identifying GGN, in a similar fashion as MIP reconstructions assist in solid nodule detection.

#### SSQ04-07 The Moment of Recognition: Method and Analysis of Gaze Behavior in the Search for Lung Nodules in CT Scans

Thursday, Dec. 3 11:30AM - 11:40AM Location: E351

##### Participants

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Brian Harrawood, MS, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

Sandy Napel, PhD, Stanford, CA (*Abstract Co-Author*) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc

Justus E. Roos, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

Kingshuk Choudhury, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

##### PURPOSE

To understand the relationship between the distance from a reader's gaze point to visible lung nodule and the momentary likelihood that the nodule will be recognized by the reader.

##### METHOD AND MATERIALS

Time-varying gaze paths were recorded while 13 radiologists interpreted 40 lung CT scans with between 3 and 5 synthetic nodules (5-mm diameter) embedded randomly within the lung parenchyma. Viewing conditions resulted in a 5° visual angle (approx. foveal limits) corresponding to a 100 pixel distance from the center of gaze. True positive (TP) gaze path segments, corresponding to all x, y, z gaze positions preceding each TP detection, were analyzed. The moment of recognition (MoR) was derived based upon analysis of gaze velocity and direction. Proceeding backwards in time from the reader's confirmation of detection, the trajectory of the gaze path was analyzed for a distinct deviation of the gaze point toward the nodule. We modeled nodule recognition as a Markov process characterized by  $R(d,z)$ , the instantaneous probability of recognizing a nodule when the gaze is centered d pixels and z sections away from the target nodule.

##### RESULTS

$R(d)$  was a decreasing function of d for all readers that was well approximated by an exponential distribution. Across readers,  $R(d)$  had a median(SD) of 84(43) and 90th percentile(SD) of 269(129) pixels. The average (SD) proportion of nodules that were recognized beyond the 100 pixel foveal limit was 51.2% (15.6%) indicating a substantial contribution of peripheral vision for lung

nodule detection.  $R(z)$  was roughly equal at CT sections that were 0, 1, and 2 from the nodule centroid and was smaller 3 sections away, with no significant difference across readers ( $p = 0.99$ ).

## CONCLUSION

The momentary likelihood of lung nodule recognition appears to decrease exponentially with distance from a lung nodule center. While on average approximately half of detected nodules are recognized with peripheral vision, readers rely on their peripheral vision for nodule detection to varying degrees. Further study of search behavior and nodule recognition may lead to strategies for greater consistency and sensitivity for lung nodules detected in CT scans.

## CLINICAL RELEVANCE/APPLICATION

Understanding the process of lung nodule detection in CT scans is important to assuring that radiologists maximize their effectiveness in diagnosing lung disease.

### SSQ04-08 Association of Focal Radiation Dose Adjusted on Body Cross Sections with Ground Glass Nodules Visibility and Quantification on Computed Tomography Images Using AIDR 3D: Comparison Among Ultra-Low- Dose, Low-Dose and Standard-Dose Scanning

Thursday, Dec. 3 11:40AM - 11:50AM Location: E351

#### Participants

Yukihiro Nagatani, MD, Otsu, Japan (*Presenter*) Nothing to Disclose  
Hiroshi Moriya, MD, Fukushima-City, Japan (*Abstract Co-Author*) Nothing to Disclose  
Satoshi Noma, MD, PhD, Tenri, Japan (*Abstract Co-Author*) Nothing to Disclose  
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Yoshiharu Ohno, MD, PhD, Kobe, Japan (*Abstract Co-Author*) Research Grant, Toshiba Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Terumo Corporation; Research Grant, Fuji Yakuhin Co, Ltd; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Guerbet SA;  
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Kiyoshi Murata, MD, Otsu, Japan (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To compare the visibility, dimension and density of ground glass nodules (GGNs) on computed tomography (CT) images using AIDR 3D between ultra-low-dose scanning (ULDS) and low-dose scanning (LDS) and assess the association of size specific dose estimate (SSDE) with difference in the measured values between ULDS as well as LDS, and standard dose scanning (SDS).

## METHOD AND MATERIALS

This was part of the ACTive Study, a multi-center research project in Japan. The Institutional Review Board of each institution approved this study, and written informed consent was obtained. In a single visit, 50 subjects underwent chest CT (64-row helical mode) using identical 320-row scanners with different tube currents: 240 (SDS), 120 (LDS), and 20 mA (ULDS). GGN visibility was assessed by 3-grade scales (1: obscure to 3: definitely visible) using SDS as standard of reference and compared between ULDS and LDS using t-test. Dimension and mean CT density (MCTD) of 71 larger GGNs with the diameter of 5mm or more and SSDE based on antero-posterior and lateral body width were determined as the average value of two-times measurements in cross sections including GGN center. Measured values were compared using Friedman and Wilcoxon signed rank test among ULDS, LDS and SDS. Pearson's correlation analyses were performed to assess the association of SSDE with relative value change between ULDS and SDS ( $RVC\#(ULDS/SDS) = 100(ULDS-SDS)/SDS$ ) and between LDS and SDS ( $RVC\#(LDS/SDS) = 100(LDS-SDS)/SDS$ ).

## RESULTS

GGN visibilities were similar between ULDS and LDS (2.746 versus 2.774) ( $p=0.67$ ). SSDE had mild negative correlation with  $RVC\#(ULDS/SDS)$  in dimension and MCTD ( $r = -0.40, p < 0.01$  and  $r = -0.31, p < 0.05$ ). Dimensions were larger at ULDS than those at LDS and SDS ( $p < 0.01$ ) ( $88.1 \pm 73.7, 82.4 \pm 69.3$  and  $80.2 \pm 66.9$ , respectively), whereas, MCTD were similar among three dose levels ( $p = 0.131$ ), as  $-626 \pm 110$  Hounsfield of Unit (HU) at ULDS,  $-619 \pm 117$  HU at LDS and  $-614 \pm 120$  HU at SDS.

## CONCLUSION

In larger GGNs at ULDS, nodular exaggerating effect in association with decreased SSDE exceeded nodular obscuration deficit due to reduced MCTD by enhanced smoothing effect, and paradoxically may result in visibilities comparable to LDS.

## CLINICAL RELEVANCE/APPLICATION

ULDS is optimal for larger GGN detection, whereas, higher dose scanning such as LDS could be desirable as quantification tool in follow-up examination of detected GGNs.

### SSQ04-09 A New Quantitative Radiomics Approach for Non-Small Cell Lung Cancer (NSCLC) Prognosis

Thursday, Dec. 3 11:50AM - 12:00PM Location: E351

#### Participants

Jiangdian Song, PhD, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose  
Caiyun Yang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Yu Dongdong, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Feng Yang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Jie Tian, PhD, Beijing, China (*Presenter*) Nothing to Disclose

## PURPOSE

To determine if computed tomographic (CT) phenotypic features of Non-Small Cell Lung Cancer (NSCLC) have the predictive ability of auxiliary diagnosis for pathological type, TNM stage by a quantitative radiomics approach.

## METHOD AND MATERIALS

The proposed method has been evaluated on a clinical dataset including 973 patients with NSCLC and a public dataset including 819 patients from the LIDC-IDRI database labelled by benign or malignancy. The proposed method consists of three phases: feature set extraction, key features selection and production. First we extracted a set of features, consisting of 3D features, Gabor features, texture features. Then a unified feature selection framework for general loss functions based on a generalized sparse regularizer was used for key feature selection. Then 25 key features were selected, the the key features were used to certify their prognostic ability.

## **RESULTS**

A score of 83.21% accuracy for lung nodule classification on 819 patients from the LIDC-IDRI dataset was obtained by the features such as Gabor 'Entropy', wavelet 'Sum Entropy' and 'Gray Level Nonuniformity'. 83.80% pathology prediction accuracy between adenocarcinoma and squamous cell carcinoma was gained from the clinical dataset by the features such as 'Maximum 3D Diameter' and run length 'Long Run Emphasis'. And 84.40% diagnosis accuracy for the early phase cancer (T1, T2) and terminal cancer (T3, T4) classification in TNM staging was achieved by 'Energy' and run length 'Long Run High Gray Level Emphasis'.

## **CONCLUSION**

Based on the key features selected from a predefined feature set we may provide a credible aided diagnosis for a tumor whose pathology type and TNM staging are unknown. The radiomics key features will be further expanded in larger data samples, which may provide more predictive information for clinical practice. Radiomics has a big potential to aid clinical diagnosis and treatment for NSCLC.

## **CLINICAL RELEVANCE/APPLICATION**

By the new quantitative radiomics method a credible diagnosis of pathological type could be obtained, it may avoid invasive frozen section and anesthesia in the clinical surgery. TNM staging is an important reference for the assessment of tumor stage and now is always determined by doctor's subjective experience. The proposed radiomics method could provide a more objective and efficient clinical staging strategy.

SSQ14

## Musculoskeletal (Soft Tissue Tumor)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E451B

**MK** **CT** **MR**

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

**FDA** Discussions may include off-label uses.

### Participants

Laura W. Bancroft, MD, Orlando, FL (*Moderator*) Royalties, Wolters Kluwer nv  
David M. Panicek, MD, New York, NY (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ14-01 Improved Detection of Melanoma Metastases Using Iodine Maps from Dual Energy CT

Thursday, Dec. 3 10:30AM - 10:40AM Location: E451B

### Awards

#### Trainee Research Prize - Resident

### Participants

Monika Uhrig, MD, DIPLPHYS, Heidelberg, Germany (*Presenter*) Nothing to Disclose  
David Simons, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Heinz-Peter Schlemmer, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Increasing workload for radiologists demands innovative solutions to preserve high quality of reports. Dual energy CT (DECT) provides contrast media mapping without a precontrast scan and allows high-contrast visualization of enhancing lesions. Goal of this study is to evaluate the potential of iodine maps (IM) from DECT to improve detection of melanoma metastases.

### METHOD AND MATERIALS

75 DECT scans (thorax (T) and abdomen (A)) from 75 melanoma patients were retrospectively analyzed. For each patient 3 conventional image reconstructions (T: lung kernel (B70f very sharp) 1mm axial and soft tissue kernel (D20f smooth) 3 mm axial, A: soft tissue kernel (D20f smooth) 3 mm axial) were performed. With commercially available software, the spectral information from DECT data was used to generate IM in axial 3 mm slices (for lung parenchyma additional 1 mm slices). These maps are comparable to color coded CT images, but the displayed voxel values base exclusively on materials which the algorithm identifies as contrast media. To facilitate radiological assessment, an overlay of IM and conventional CT (cCT) was provided. A radiologist analyzed initially cCT and afterwards the IM. Number, localization and characterization of lesions detected additionally by assessing the IM were reported.

### RESULTS

In 29 patients in total 44 lesions (17 metastases) were additionally detected on IM. All lesions could retrospectively be identified on cCT and were located in the liver (34%), inter- or intramuscular (23%), subcutaneous (9%), lung (7%), mesenterial (5%), intestinal (5%), mediastinal (5%), skeleton (4%), pancreas (2%), vagina (2%), supraclavicular (2%) and peritoneal (2%). Lung findings include 2 pulmonary emboli.

### CONCLUSION

In view of increased workload powerful tools supporting a fast and accurate assessment of radiological images are essential. This study demonstrates that IM from DECT improve detection of metastases as well as relevant secondary findings like pulmonary emboli in staging examinations of melanoma patients. To the best of our knowledge, the potential of iodine maps for lesion detection in staging examinations has not been shown before.

### CLINICAL RELEVANCE/APPLICATION

Increased workload bears the risk of impaired quality of CT reports. IM from DECT improve detection of metastases and relevant secondary findings without increasing radiation dose.

#### SSQ14-02 Diagnostic Performance of Diffusion-weighted and Dynamic Contrast Enhanced (DCE) MR Images for Evaluating Soft-tissue Tumors

Thursday, Dec. 3 10:40AM - 10:50AM Location: E451B

### Participants

You Seon Song, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose  
In Sook Lee, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jong Woon Song, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jin Il Moon, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate the diagnostic efficacy of diffusion-weighted (DW) and dynamic contrast enhanced (DCE) MR images for evaluating soft-tissue tumors.

### METHOD AND MATERIALS

Between September 2012 and March 2015, 102 patients (57 female, 45 male, age range, 11-86 years; mean age, 47.7 years) who

had soft-tissue tumors performed MR examinations including DWI and DCE images. We investigated the size and signal intensities of the mass on conventional MR images. On DWI, we obtained the values of ADC (apparent diffusion coefficient) and evaluated the presence or absence of diffusion restriction visually. We obtained the values of K<sub>tr</sub>, K<sub>ep</sub>, V<sub>e</sub>, and iAUC, and time-concentration curve (TCC) of 7 types on DCE images. These results were compared between benign and malignant lesions statistically.

## RESULTS

Malignant lesions were 28 cases and benign 74. DWIs were not obtained adequately in 8 cases. For differentiating between benign and malignant lesions, the sex of patient, and the size and signal intensities of the mass were not significant. However, the age of patient and the margin of the mass were significant. On DWI, the values of minimum and mean ADC and the presence or absence of diffusion restriction visually were significant. On DCE MR images, the values of K<sub>tr</sub>, K<sub>ep</sub>, iAUC and the types of TCC were significant.

## CONCLUSION

For the differentiating benign and malignant soft-tissue lesions, added DWIs and DCE MR images were very effective and thus these quantitative evaluations might be necessary.

## CLINICAL RELEVANCE/APPLICATION

There are many indistinct cases in the differentiation of benign from malignant lesions with only conventional MR images. In the future, the quantitative analyses by using functional MR images might be helpful for distinguishing between benign and malignant soft tissue lesions.

### SSQ14-03 Does CT Imaging Have the Ability to Identify the Dedifferentiated Component (DDLPS) in a Retroperitoneal Well Differentiated Liposarcoma (WDLPS)?

Thursday, Dec. 3 10:50AM - 11:00AM Location: E451B

#### Participants

Jieqi Wang, BA, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Priya R. Bhosale, MD, Houston, TX (*Presenter*) Nothing to Disclose  
Datla G. Varma, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Corey T. Jensen, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Tara L. Sagebiel, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Madhavi Patnana, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Chitra Viswanathan, MD, Houston, TX (*Abstract Co-Author*) Consultant, Hollister Incorporated  
Neeta Somaiah, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate the CT imaging features which may predict the presence of a DDLPS component within a retroperitoneal WDLPS.

#### METHOD AND MATERIALS

49 treatment naive patients with WDLPS (12) or DDLPS (37) who underwent computed tomography (CT) were included in the study following approval of the institutional review board. Three Radiologists evaluated the studies independently in a blinded fashion on a diagnostic workstation for < or >25% fat, presence of a ground glass nodule (a nodule having as attenuation lower than adjacent psoas muscle and hazy internal architecture), enhancing nodule (higher attenuation than psoas muscle), necrotic nodule (enhancing nodule with central areas of low attenuation), capsule surrounding the mass, septations, calcification (popcorn, spiculated or curvilinear), and final diagnosis of WDLPS or DDLPS. Statistical analysis Multivariate logistic regression model with generalized estimating equations (GEE) method was used to correlate imaging features with pathology. P-values of 0.05 or less were considered statistically significant. Kappa Statistics were performed to assess agreement of the 5 features by all the three radiologists.

#### RESULTS

The accuracy, sensitivity, specificity, positive predictive value and negative predictive values to diagnose the DDLPS in the WDLPS were 75.5%, 91.7%, 70.2%, 50.0% and 96.3%, 79.6%, 91.7%, 75.7%, 55.0% and 96.5% and 73.3%, 91.7%, 67.6%, 47.8% and 96.5% for reader 1, 2 and 3. All three readers showed almost perfect agreement in overall diagnosis based on Kappa statistics [95% confidence interval  $\kappa = 0.83$  (0.63 to 0.99)]. The presence of an enhancing nodule was highly suggestive of DDLPS ( $P < 0.02$ ).

#### CONCLUSION

The presence of an enhancing nodule is highly specific for the diagnosis of DDLPS component in a retroperitoneal WDLPS.

#### CLINICAL RELEVANCE/APPLICATION

Imaging may help guide appropriate biopsy of the dedifferentiated component within a well differentiate liposarcoma which can further help streamline patient management

#### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Priya R. Bhosale, MD - 2012 Honored Educator

### SSQ14-04 Value of US Imaging in the Diagnosis of Epidermal Cysts

Thursday, Dec. 3 11:00AM - 11:10AM Location: E451B

#### Participants

Vasiliki Perlepe, MD, Brussels, Belgium (*Presenter*) Nothing to Disclose  
Nicolas Michoux, Brussels, Belgium (*Abstract Co-Author*) Nothing to Disclose

Bruno C. Vande Berg, MD, PhD, Brussels, Belgium (*Abstract Co-Author*) Consultant, Bone Therapeutics SA  
Frederic E. Lecouvet, MD, Brussels, Belgium (*Abstract Co-Author*) Nothing to Disclose  
Liliane Marot, Woluwe-St Lambert, Belgium (*Abstract Co-Author*) Nothing to Disclose  
Jacques Malghem, MD, Brussels, Belgium (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate the ultrasonographic appearance of subcutaneous soft-tissue tumors and pseudo-tumors with a focus on epidermal cysts.

## METHOD AND MATERIALS

112 small subcutaneous nodules (mean maximum size: 9.7mm) with US imaging and pathologic correlation were included in this retrospective study. The histopathology revealed 7 ganglion cysts, 24 epidermal cysts, 10 pilomatricomas, 47 benign tumors (including 25 lipomas), 9 malignant tumors and 15 various lesions. One MSK radiologist with 20 years of experience analysed several US imaging features of the lesions: morphology, margins, size, echogenicity, Doppler signal, peripheral halo, focal intra-dermal penetration, relative skin thinning opposite to the mass, posterior acoustic enhancement, lateral shadows. ROC analysis was performed to evaluate the performance of individual parameters and that of a multi-parametric model using logistic regression in the specific identification of epidermal cysts.

## RESULTS

Best imaging parameters were posterior acoustic enhancement (AUC = 0.87, Se = 100%, Sp = 65%), lateral shadows (AUC = 0.83, Se = 75%, Sp = 91%), Doppler signal=0 (AUC = 0.75, Se = 86%, Sp = 63%), well-defined margins (AUC = 0.74, Se = 96%, Sp = 27%), relative skin thinning (AUC = 0.71, Se = 100%, Sp = 35%) and focal intra-dermal penetration (AUC = 0.65, Se = 42%, Sp = 89%), showing a performance ranging from moderate to good. A multi-parametric model based on 4 parameters (posterior acoustic enhancement, well-circumscribed margins, lateral shadows and Doppler) allowed diagnosis of epidermal cysts with a very good performance (AUC = 0.96, Se = 91%, Sp = 94%).

## CONCLUSION

A computer-aided decision based on a multi-parametric model of US imaging features of subcutaneous lesions allows diagnosis of epidermal cysts. Further tests on a larger cohort of patients are needed to confirm the performance of the present model.

## CLINICAL RELEVANCE/APPLICATION

Ultrasound is a reliable imaging technique for the diagnosis of epidermal cysts.

## SSQ14-05 Indeterminate Soft Tissue Tumors: How Good is Noncontrast Imaging with Quantitative DWI at Distinguishing Benign from Malignant Disease Compared with Contrast-enhanced Imaging?

Thursday, Dec. 3 11:10AM - 11:20AM Location: E451B

### Participants

Filippo Del Grande, MD, MBA, Baltimore, MD (*Presenter*) Nothing to Disclose  
Shivani Ahlawat, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Ty K. Subhawong, MD, Miami, FL (*Abstract Co-Author*) Nothing to Disclose  
Laura M. Fayad, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To assess the added value of contrast enhanced sequences (static [CE] and dynamic [DCE]) to noncontrast imaging (T1, fluid-sensitive and quantitative diffusion weighted imaging [DWI] with apparent diffusion coefficient [ADC] mapping) for distinguishing benign and malignant soft tissue tumors (STTs).

## METHOD AND MATERIALS

Forty-three patients with indeterminate STTs referred for biopsy underwent 3T MRI with conventional noncontrast (T1-weighted, fluid-sensitive), DWI (b-values 50, 400, 800 with ADC mapping), and post-contrast imaging (DCE at 7 second time resolution, delayed static CE). Two readers independently reviewed imaging in 4 sessions (conventional noncontrast alone, conventional + DWI/ADC maps, conventional + DWI/ADC maps + CE images, conventional + DWI/ADC maps + CE + DCE all together). Readers recorded the likelihood of malignancy by a 5 point scale (definitely benign, probably benign, possibly malignant, probably malignant, definitely malignant) at each session; interobserver variability (weighted kappa (k)) and accuracy (ROC analysis) were calculated.

## RESULTS

Of 43 indeterminate STTs, 31 were benign and 12 were malignant. The accuracy for distinguishing benign and malignant disease (ROC analysis in Figure 1) was highest with the addition of DCE (area under curve (AUC) 0.87 for both readers), although non-contrast imaging (conventional and quantitative DWI) performed similarly to imaging with the addition of static CE sequences (AUC 0.82-0.78 and 0.82-0.81 for 2 readers respectively). Inter-observer agreement was highest with contrast (k 0.83(CE) and 0.82(DCE)), but was lower for non-contrast conventional without (k 0.55) or with DWI (k 0.66).

## CONCLUSION

The addition of DCE sequences increases the diagnostic performance of MRI to distinguish benign and malignant STTs. Although non-contrast sequences alone (conventional and DWI) offer diagnostic performance similar to conventional sequences with static CE, their inter-reader reliability is lower.

## CLINICAL RELEVANCE/APPLICATION

Non-contrast imaging with DWI offers reasonable diagnostic performance for characterizing STTs for malignancy, if intravenous contrast is administered, DCE is likely more valuable than static CE imaging.

## SSQ14-06 Exploring the Value of Fiber Tractography Used for Describing Relations of Soft Tissue Tumors and the Peritumoral Muscle

Thursday, Dec. 3 11:20AM - 11:30AM Location: E451B

## Participants

Lingxin Kong, Dalian, China (*Presenter*) Nothing to Disclose  
Qingwei Song, MD, Dalian, China (*Abstract Co-Author*) Nothing to Disclose  
Zhang Lina, Da Lian, China (*Abstract Co-Author*) Nothing to Disclose  
Shaowei Zheng, Dalian, China (*Abstract Co-Author*) Nothing to Disclose  
Shao Wu Wang, MD, Dalian, China (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To study value of the diffusion tensor imaging, fiber tracer Tractography (FT) on soft tissue tumors and relationship of the tumor around muscle on 3.0 T MRI.

## METHOD AND MATERIALS

1.General Information:Collected 30 patients with soft tissue mass during the period of from June 2014 to March 2014 in our hospital. 16 cases of men in, 14 cases of women. All will be divided into three groups: 12 cases in intermuscular malignant tumor group; 12 cases in intermuscular benign tumor group; And 6 cases in intramuscular tumor group.2. Observe indicator:According to the FT reconstruction image form and FS-T2WI signal changed muscle into four types. Type I: peritumoral muscles appear only displacement change, muscle fiber continuous, muscle FS-T2WI signal has no exception. Type II: peritumoral muscle appear edema or inflammatory change, FS-T2WI sequences signal increased, muscle fiber bundle is still continuous. Type III: Tumor invasive peritumoral muscle fibers, but a certain number of fiber bundles can still imaging, FS-T2WI sequence signal unevenly increased. Type IV: Tumor will destroyed peritumoral muscle, muscle fiber bundle interruption.3. Statistical methods:Muscle outside benign group and malignant group, within muscle tumor group FT reconstruction type composition differences result using the Fisher's exact probability method test.

## RESULTS

83.33% of intermuscular benign tumor group tumor showed the type I; 41.67% of intermuscular malignant tumor group showed type III,25% of intermuscular malignant tumor group showed type IV;100% intramuscular tumor group showed type IV, difference had statistical significance (P = 0.00).

## CONCLUSION

FT reconstructions can reflect tumor growth way, intuitive shows the degree of muscle fiber infringement, outside benign and malignant peritumoral muscle with different kinds of FT reconstruction, within the intramuscular tumor peritumoral muscle FT reconstruction showed type IV.

## CLINICAL RELEVANCE/APPLICATION

FT reconstructions can reflect tumor growth way, intuitive shows the degree of muscle fiber infringement, outside benign and malignant peritumoral muscle with different kinds of FT reconstruction, within the intramuscular tumor peritumoral muscle FT reconstruction showed type IV.

## SSQ14-07 Role of the PET-CT in the Evaluation of the Extra Osseous Soft Tissue Sarcomas

Thursday, Dec. 3 11:30AM - 11:40AM Location: E451B

## Participants

Sikandar M. Shaikh, DMRD, Hyderabad, India (*Presenter*) Nothing to Disclose

## PURPOSE

To evaluate the role of the extra osseous soft tissue sarcomas by using fused positron emission tomography/computed tomography (PET/CT) .To evaluate the usefulness for the clinicians in decision making more than standard CT +/- magnetic resonance imaging (MRI) imaging .

## METHOD AND MATERIALS

A retrospective study was done to evaluate the role of PET-CT in cases of pathologically proven extra osseous soft tissue sarcomas. Eighteen patients were included in the study with different locations of soft tissue tumors. PET-CT was done after injecting the FDG contrast after one hour .All the adult age group patients were included in the inclusion criteria which included the various parameters of histology, staging, imaging data, imaging reports, treatments, follow-up, and disease status were compiled. A 6-variable scoring system (tumor involvement, regional disease detection, distant metastases detection, malignant determination, tumor avidity, change in treatment) to examine imaging utility was devised.

## RESULTS

In 12 patients (67%), PET/CT was superior to CT/MRI, while the latter was superior in only 3 patients (16%). Neither modality was superior in 3 patients (16%). PET/CT was able to identify regional or distant disease by staging in 8 patients (44%), while CT/MRI did not (0%). CT/MRI showed more potentially involved tissue than in PET/CT. In 8/18 patients (44%), PET/CT could better distinguish between malignant and non-malignant tissue; 10/18 patients (56%) were equivocal. The use of PET/CT led to a documented change in the patient's treatment plan in 11/18 patients (61%), compared to 1/18 change for CT/MRI (5%). In looking at overall utility of PET/CT vs. CT/MRI in the 6 variables, PET/CT scored significantly higher (Chi-squared, P = 0.02).

## CONCLUSION

For extraosseous soft tissue sarcomas , PET/CT is more helpful in evaluating the regional and distant disease involvement, and differentiating from malignant and non-malignant lesions. Compared to CT/MRI data, PET/CT has a greater impact on the treatment and management of patients.

## CLINICAL RELEVANCE/APPLICATION

THUS PET-CT HAS IMPORTANT ROLE IN EVALUATING THE SOFT TISSUE SARCOMAS.

## SSQ14-08 Detection of Soft Tissue Sarcoma Recurrence: Use of Additive Qualitative and Quantitative Diffusion-weighted MR Imaging to Standard MR Imaging at 3.0 T



Thursday, Dec. 3 11:40AM - 11:50AM Location: E451B

#### Participants

Borim Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Won-Hee Jee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Investigator, Bayer AG; Research support, Bayer AG ;  
So-Yeon Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Joon-Yong Jung, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Chan-Kwon Jung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Seung Han Shin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Yang-Guk Chung, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To retrospectively determine the added value of diffusion-weighted imaging (DWI) to standard magnetic resonance imaging (MRI) to detect recurrent soft tissue sarcoma after surgical resection at 3.0 T.

#### METHOD AND MATERIALS

The institutional review board approved this retrospective study and informed consent was waived. From June 2009 through April 2014, 30 patients without residual tumor referred for postoperative surveillance of soft tissue sarcoma underwent 3T MRI including DWI. Two independent musculoskeletal radiologists first scored standard MRI. Then, they assessed a combination of standard MRI and qualitative and quantitative DWI. Interobserver agreement for apparent diffusion coefficient (ADC) measurement in recurrent soft tissue sarcoma was assessed using intraclass correlation coefficient (ICC). The receiver operating characteristic (ROC) curve with areas under the curve (AUC) was obtained for diagnostic performance.

#### RESULTS

There were 13 histologically proved recurrent soft tissue sarcoma in nine patients. In qualitative analysis of DWI, all recurrent soft tissue sarcoma revealed hyperintensity relative to skeletal muscle. In quantitative analysis of recurrent soft tissue sarcoma, median ADCs of two readers were 1025 (774-1092)  $\mu\text{m}^2/\text{sec}$  and 996 (801-1126)  $\mu\text{m}^2/\text{sec}$ , respectively, showing excellent interobserver agreement (ICC = 0.900). Sensitivity, specificity and accuracy of each reader were 69%, 81%, and 77%; 92%, 57%, and 71% on standard MRI alone, whereas 100%, 95%, and 97%; 92%, 95%, and 94% on standard MRI combined DWI, respectively. AUCs of a combination of standard MRI and DWI were higher than those of standard MRI alone: 0.824 vs 0.969 (P = .029), and 0.866 vs 0.958 (P = .127) for each reader, respectively.

#### CONCLUSION

The addition of DWI to standard MRI improves the detection of recurrent soft tissue sarcoma at 3.0 T.

#### CLINICAL RELEVANCE/APPLICATION

DWI should be added to standard MRI protocols to help detect the recurrent soft tissue sarcoma.

#### SSQ14-09 3D Volumetric MRI with Isotropic Resolution: Improved Speed of Acquisition, Spatial Resolution and Assessment of Lesion Conspicuity in Patients with Recurrent Soft Tissue Sarcoma

Thursday, Dec. 3 11:50AM - 12:00PM Location: E451B

#### Participants

Shivani Ahlawat, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Carol Morris, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Laura M. Fayad, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

#### PURPOSE

To assess 3D volumetric MR sequences with isotropic resolution for acquisition speed, image quality and lesion conspicuity in detecting recurrent soft tissue sarcomas (STS).

#### METHOD AND MATERIALS

15 subjects with resected STS and histologically-proven recurrent disease underwent MRI with axial and coronal T1-weighted (spin echo, 5mm slice thickness) and fluid-sensitive sequences (5mm slice thickness). Coronal 3D volumetric T1-weighted sequences (fat-suppressed volume-interpolated breath-hold examination, TR/TE 3.7/1.4, 9.5° flip angle, 1-mm-thick sections) were obtained before and after intravenous contrast administration, with subtraction imaging (subtraction of pre-contrast from post-contrast 3D acquisitions) and multiplanar reconstructions (MPRs) in the axial and sagittal planes. Acquisition times for spin echo T1-weighted sequences in 2 planes and 3D sequences were reported. Two musculoskeletal radiologists reviewed imaging for image quality (artifacts >50%, artifacts 25-50%, no substantial artifacts), conspicuity of recurrent lesions (contrast-to-noise ratio (CNR)) on unsubtracted and subtracted 3D images, size of recurrences and distance from nearest joint on MPR views. Descriptive and intraclass correlation statistics were given.

#### RESULTS

For 15 recurrent tumors, average imaging times were significantly reduced for 3D imaging compared with 2-plane T1-weighted imaging (317.6 vs 745.2 seconds). Image quality was rated as having no substantial artifacts in 15/15. Lesion conspicuity was significantly improved for subtracted vs unsubtracted images (CNR 52.9+/-8.9 vs 5.0+/-3.0, p = 0.00064). Recurrent lesion size ranged from 0.7 to 5.7 cm, with average size of 2.5 cm, and measurements on 3D sequences offered excellent interobserver agreement between readers (ICC 0.98 for lesion size and ICC 0.96 for recurrence-to-joint distance with MPR views).

#### CONCLUSION

T1-weighted 3D volumetric sequences with isotropic resolution offer higher spatial resolution, multiplanar capability, and significantly faster acquisition times than spin echo T1-weighted imaging. In addition, higher lesion conspicuity is achieved with subtraction imaging than unsubtracted images for detecting recurrent STS.

#### CLINICAL RELEVANCE/APPLICATION

A T1-weighted 3D volumetric sequence is a fast alternative to spin echo imaging for 3-plane anatomic post-contrast imaging, and can be coupled with subtraction imaging for greater lesion conspicuity in the detection of recurrent tumors.

MSCS52

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

Thursday, Dec. 3 10:30AM - 12:00PM Location: S406A

**MK**

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

### Participants

Lynne S. Steinbach, MD, San Francisco, CA, (lynne.steinbach@ucsf.edu) (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify the application of basic anatomic, pathologic, and physiologic principles to tumors as well as specific disease processes that affect the knee, hip, ankle and foot. 2) Illustrate using case examples of several important disease processes that are characteristic of the chosen topics, using several imaging methods and emphasizing the value of each. 3) Present the major teaching points and differential diagnostic considerations for each of the chosen cases and, when appropriate, clarify the importance of early accurate diagnosis.

### ABSTRACT

Accurate diagnosis of many disorders that affect the knee, hip, ankle and foot as well as musculoskeletal tumors can be accomplished with basic or advanced imaging methods, or both. A series of cases will be used to illustrate a few of these disorders, with attention to the most appropriate imaging protocol, the salient imaging findings, the anatomic and pathophysiologic factors that explain the findings, and the important differential

### Sub-Events

#### MSCS52A Tumor

### Participants

Mark J. Kransdorf, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

### ABSTRACT

#### MSCS52B Ankle and Foot

### Participants

Donald L. Resnick, MD, San Diego, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### MSCS52C Knee

### Participants

William E. Palmer, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### MSCS52D Hip

### Participants

Christian W. Pfirrmann, MD, MBA, Forch, Switzerland (*Presenter*) Advisory Board, Siemens AG; Consultant, Medtronic, Inc

### LEARNING OBJECTIVES

View learning objectives under main course title.

SSQ20

## Physics (CAD)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S404AB



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

### Participants

Heang-Ping Chan, PhD, Ann Arbor, MI (*Moderator*) Institutional research collaboration, General Electric Company  
Hiroyuki Yoshida, PhD, Boston, MA (*Moderator*) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

### Sub-Events

#### SSQ20-01 Automatic Spatial Linking of Lesions in Breast MRI Follow-up Images

Thursday, Dec. 3 10:30AM - 10:40AM Location: S404AB

### Participants

Lei Wang, Bremen, Germany (*Presenter*) Nothing to Disclose  
Albert Gubern-Merida, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Susanne D. Diekmann, MD, MSc, Bremen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Speakers Bureau, Bayer AG  
Hendrik O. Laue, PhD, Bremen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Horst K. Hahn, PhD, Bremen, Germany (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Automatically linking the lesions detected in breast MRI follow-up examinations is required for the development of a computer-aided diagnosis (CAD) system to quantify characteristic changes of the lesions. In this work, we develop a registration-based method that enables automatic linking of lesions detected in breast MRI follow-up studies.

### METHOD AND MATERIALS

From 51 subjects participating in a MRI screening program, we collected 102 dynamic contrast enhanced MRI (DCE-MRI) images, forming 51 pairs of follow-up studies. Current and prior examinations were acquired in different scanners with a time interval of one year, using transversal and coronal views, respectively. One experienced radiologist manually placed 71 pairs of markers, indicating the center locations of 71 pairs of lesions found in both current and prior studies. Automatic lesion linking is achieved by registering current and prior MRI examinations. First, a motion correction algorithm is performed on both current and prior DCE-MRI. Then, fully automatic breast segmentation is applied on the current and prior pre-contrast images to extract breast masks, which are used to obtain an initial affine transform. Then, a non-rigid registration algorithm using normalized gradient fields as similarity measure together with curvature regularization is exploited to register the current and prior pre-contrast images. Since the follow-up scans may have inconsistent field of views, the registration only focuses on the segmented breast regions to enforce the alignment accuracy in breast areas, such that non-breast regions will not attract and influence the registration process.

### RESULTS

Based on the deformation fields obtained by registration, markers labeling the lesions in the current image were transformed to the prior image frame, where the distance between the transformed markers and the markers originally labeled in prior images was computed. The average distance error was  $9.6 \pm 9.3$  mm.

### CONCLUSION

The proposed system is potentially applicable to automatically link the lesions detected in a CAD system to investigate the characteristic changes.

### CLINICAL RELEVANCE/APPLICATION

Visual assessment and comparison of characteristic change of the lesions in breast DCE-MRI follow-up exams is time consuming, and computer-aided lesion comparison may increase clinical effectiveness.

#### SSQ20-02 Information-preserving Pseudo-enhancement Correction for Computer-aided Detection (CADE) in Dual-energy CT Colonography (DE-CTC)

Thursday, Dec. 3 10:40AM - 10:50AM Location: S404AB

### Participants

Janne J. Nappi, PhD, Boston, MA (*Presenter*) Royalties, Hologic, Inc; Royalties, MEDIAN Technologies;  
Se Hyung Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Research Grant, Mallinckrodt plc; Research Grant, Samsung Electronics Co Ltd  
Hiroyuki Yoshida, PhD, Boston, MA (*Abstract Co-Author*) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

### PURPOSE

To evaluate the effect of information-preserving pseudo-enhancement correction on the accuracy of computer-aided detection (CADE) in dual-energy CT colonography (DE-CTC).

### METHOD AND MATERIALS

Twenty patients were prepared for a DE-CTC examination by use of one-day bowel preparation with 18 g of magnesium citrate and 50 ml of non-ionic iodine. The DE-CTC image acquisitions (SOMATOM Definition, Siemens Healthcare) were performed at 140 kVp and 80 kVp energies in supine and prone positions with 1-mm slice thickness. No intravenous contrast was used. An experienced

board-certified radiologist correlated the CTC images with the findings of subsequent optical colonoscopy. The DE-CTC images were then subjected to a novel dual-energy pseudo-enhancement correction method that corrects for pseudo-enhancement distortions of soft tissue on DE-CTC images caused by adjacent orally administered high-density fecal tagging, without distorting the dual-energy information that is contained within the images. For evaluation, a dual-energy CADe (DE-CADe) scheme was used to detect challenging polyps 6 - 9 mm in size from the DE-CTC images without and with the application of the pseudo-enhancement correction. The detection performance of the DE-CADe scheme was assessed by use of leave-one-patient-out evaluation.

## RESULTS

There were 15 colonoscopy-confirmed polyps measuring 6 - 9 mm in largest diameter. Without the pseudo-enhancement correction, the DE-CADe scheme detected 9 polyps (60%) at 4.3 false-positive (FP) detections per patient and 10 polyps (67%) at 53 FP detections per patient. With the application of the dual-energy pseudo-enhancement correction method, the DE-CADe scheme detected 12 polyps (80%) at 5.5 FP detections per patient. For larger polyps (n=14), the detection sensitivity was 93% without and 100% with the pseudo-enhancement correction.

## CONCLUSION

The information-preserving dual-energy pseudo-enhancement correction method can improve the detection accuracy of CADe for challenging colorectal lesions in DE-CTC.

## CLINICAL RELEVANCE/APPLICATION

The proposed method can improve the accuracy of CADe and quantitative imaging in DE-CTC by correcting for pseudo-enhancement distortions of images without changing their dual-energy information.

### SSQ20-03 Evaluation of a Novel Method to Segment the Pectoral Muscle Surface in Automated Whole Breast Ultrasound

Thursday, Dec. 3 10:50AM - 11:00AM Location: S404AB

#### Participants

Albert Gubern-Merida, PhD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose  
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## PURPOSE

Segmentation of anatomical structures in automated 3D breast ultrasound (ABUS) is required for development of computer-aided detection (CAD) and other techniques to make clinical workflow more efficient, such as automatic linking of findings between different ABUS views and multimodal registration. We propose a novel method to segment the anterior pectoral surface in ABUS images.

## METHOD AND MATERIALS

We randomly collected 74 ABUS (25 Anterior-Posterior, 15 MEDial, 31 LATeral and 3 SUPerior views) volumes obtained in routine clinical care at two medical centers using the S2000 automated 3D breast ultrasound system (Siemens, Erlangen, Germany). Manual pectoral muscle delineations of the anterior surface were provided by a trained researcher. We developed an algorithm to segment the pectoral muscle surface in ABUS volumes: First, the chest wall is segmented using a previously validated software that models the chest wall as a cylinder. Thereafter, the chest wall surface is used to perform a cylindrical transformation on the ABUS volume. By applying this transformation, the chest wall and the pectoral muscle are straightened and shape variability of the pectoral muscle across volumes can be encoded in a probabilistic atlas. In the last step, gradient and atlas information are used to guide the pectoral muscle surface segmentation in a dynamic programming approach. The algorithm was applied to the 74 ABUS volumes of the study dataset following a leave-one-out strategy. Distance (mean+stdev) between manual and automated pectoral muscle surfaces was used as evaluation measure.

## RESULTS

The presented approach achieved a mean surface distance error of 3.47±3.03 mm, compared to the manual annotations. The surface distance error for AP, LAT, MED and SUP view volumes was 2.61±4.15, 3.78±4.15, 4.17±2.37 and 3.78±1.02 mm, respectively.

## CONCLUSION

Automated pectoral muscle segmentation is challenging due to high variation in pectoral muscle anatomy. The proposed method shows promising results on segmenting the pectoral muscle surface.

## CLINICAL RELEVANCE/APPLICATION

ABUS is a promising modality for screening but reading is time consuming for radiologists. Availability of supporting tools such as computer-aided detection may expedite introduction of ABUS in practice.

### SSQ20-04 Automatic Coronary Calcium Scoring and Cardiovascular Risk Estimation in the Pan-Canadian Lung Cancer Screening Trial

Thursday, Dec. 3 11:00AM - 11:10AM Location: S404AB

#### Participants

Nikolas Lessmann, Utrecht, Netherlands (*Presenter*) Nothing to Disclose  
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Bram Van Ginneken, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) 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**

Coronary artery calcium (CAC) scores determined in low-dose ungated chest CT, as acquired for lung cancer screening, strongly and independently predict cardiovascular events (CVE). Automatic CAC scoring can complement lung cancer screening by identifying subjects at risk of a CVE. We investigated agreement and reliability of an automatic CAC scoring method previously developed for CAC scoring in the Dutch-Belgian lung cancer screening trial (NELSON) in the Pan-Canadian Early Detection of Lung Cancer Study (PanCan).

#### **CONCLUSION**

Automatic coronary calcium scoring in lung cancer screening CT scans is feasible. To achieve good agreement with manual scores representative training data was not necessary.

#### **CLINICAL RELEVANCE/APPLICATION**

Automatic quantification of cardiovascular risk in lung cancer screening programs can identify subjects at high risk who might benefit from preventive treatment. This might improve the overall cost-effectiveness.

### **SSQ20-05 Leveraging Mid-Level Semantic Boundary Cues for Computer-Aided Lymphadenopathy Detection**

Thursday, Dec. 3 11:10AM - 11:20AM Location: S404AB

#### **Participants**

Ari Seff, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose  
Le Lu, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose  
Ronald M. Summers, MD, PhD, Bethesda, MD (*Presenter*) Royalties, iCAD, Inc; Research funded, iCAD, Inc;

#### **PURPOSE**

To improve an automated system for detection of mediastinal and abdominal enlarged lymph nodes (LNs) (>10 mm in short axis diameter) on CT scans.

#### **METHOD AND MATERIALS**

Two lymph node CT datasets (90 patients with 388 mediastinal LNs and 86 patients with 595 abdominal LNs) were used. Images were acquired in the portal venous phase with a slice thickness of 1-1.25 mm. A radiologist examined each scan, manually segmenting all ground truth enlarged LNs. Accompanying each target region was a list of previously generated LN candidate centroids. For each candidate, nine 2D views of size 45×45 voxels were sampled one voxel apart, along each of the three orthogonal planes. Patches of size 15×15 voxels were extracted from the 2D views and labeled as positive if the center resided on a LN boundary. 150 representative LN contour classes (known as sketch tokens) were defined via k-means clustering. Patch-level gradient channels and self-similarity channels were used to train a random forest classifier for contour classification. The random forest model was then used to obtain 150 contour class probability scores per voxel for all 2D views. Taking the voxel-wise sums and maximums of the scores resulted in two new boundary cue maps. In addition to the raw CT intensity images, these two maps served as additional inputs for HOG computation. A linear SVM was trained using the three concatenated feature sets for classification of views as containing LN or not. The mean of the resulting view-level scores served as the candidate score.

#### **RESULTS**

Six-fold cross-validation demonstrated that the enhanced feature maps lead to 15%-23% greater recall than the baseline HOG (e.g., 78% versus 56% sensitivity at 3 FP/scan in the abdomen and 78% versus 63% at 3 FP/scan in the mediastinum). This performance improvement was found to be statistically significant via paired-sample t-tests ( $p \ll .01$ ). Additionally, our system outperformed the state-of-the-art deep learning system in the mediastinal region (e.g. 78% vs. 70% sensitivity at 3 FP/scan).

#### **CONCLUSION**

We developed a novel method to learn enriched, semantic feature maps that facilitate significantly improved performance for automated lymph node detection.

#### **CLINICAL RELEVANCE/APPLICATION**

Detection of lymphadenopathy is critical for cancer staging and assessing treatment response. Automated detection may permit more accurate and time efficient assessment.

### **SSQ20-06 Feasibility of Fully Automatic Coronary Artery Calcium Scoring and Cardiovascular Risk Determination with Radiation Therapy Treatment Planning CT of Breast Cancer Patients**

Thursday, Dec. 3 11:20AM - 11:30AM Location: S404AB

#### **Participants**

Ivana Isgum, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Research Grant, Pie Medical Imaging BV; Research Grant, 3mensio Medical Imaging BV;  
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#### **PURPOSE**

Coronary artery calcifications (CAC) are strong and independent predictors of cardiovascular events and all-cause mortality. The

aim of this study was to investigate the agreement between automatic and manual CAC scoring and determination of cardiovascular risk in radiation therapy (RT) treatment planning CT acquired in breast cancer patients.

## METHOD AND MATERIALS

This study included 461 female breast cancer patients undergoing RT planning CT (Philips, 16 x 0.75 mm collimation, 120 kVp, 3 mm section thickness, no-ECG synchronization, with or without breath-hold). Calcium was scored automatically using an algorithm developed for CAC scoring in low-dose chest CT that employs supervised pattern recognition to identify CAC by texture, size, and spatial features. To determine agreement of automatic cardiovascular disease (CVD) risk assignment, all scans with CAC score >0 and an equal number of randomly selected zero score images were chosen for manual expert CAC scoring. Only one scan per patient was analyzed. Scoring was performed with standard 130 HU threshold. Reference and automatic Agatston scores were computed. Each patient was assigned to a CVD risk category based on the Agatston score (0, 1-10, 10-100, 100-400, >400). Agreement was computed as proportion of agreement between automatic and manual risk category assignment. Proportion of agreement beyond chance was determined using linearly weighted kappa for risk category assignment between automatic and manually determined risk categories.

## RESULTS

162 scans were analyzed. Reference CAC score in 80 images was zero. In the remaining scans, reference median Agatston score was 76.1 (range 1.2-1745.5). Automatic and manual expert scoring assigned 78% (126/162) of patients to the same CVD risk category. This was higher for patients scanned with breath-hold (86%, 48/56) than for those without (74%, 78/106). Linearly weighted kappa was 0.78 (95% CI: 0.71-0.85). For patients scanned with and without breath-hold this was 0.83 (CI: 0.72-0.94) and 0.75 (CI: 0.66-0.84), respectively.

## CONCLUSION

Automatic CVD risk determination in RT treatment planning CT for breast cancer patients results in good agreement with manual expert scoring. Agreement is higher when scanning is performed with breath-holding.

## CLINICAL RELEVANCE/APPLICATION

Fully automatic CAC scoring and CVD risk determination in breast cancer patients undergoing RT treatment planning CT is feasible without additional costs.

## SSQ20-07 Automatic Detection of Interval Changes between Low-Dose CT Images Using Subtraction Images

Thursday, Dec. 3 11:30AM - 11:40AM Location: S404AB

### Participants

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## PURPOSE

To develop an automatic system for detecting interval changes between low-dose CT images in a lung cancer screening setting using analysis of subtraction images.

## METHOD AND MATERIALS

Given two CT scans, a prior and a current scan, lung segmentation and non-rigid registration is performed and a subtraction image is obtained by subtracting the deformed prior scan from the current scan. In the subtraction image, potential candidate regions with true change are determined using banded thresholding and morphological operations. For each candidate, a set of intensity, shape and context features is computed. A GentleBoost classifier using 250 regression stumps is used to differentiate real change from subtraction artifacts. We selected all subjects which had been referred to a pulmonologist from one site of the NELSON lung cancer screening trial. Per subject, we selected the scan on which the referral was based upon and the corresponding prior scan. This resulted in 124 scan pairs which were divided randomly into a training and test set. In addition, 50 random pairs of CT scans for which long-term follow-up had been scheduled were selected as additional normal cases for the test set. An experienced radiologist annotated all relevant changes (volume change of preexisting nodules, mucus in airways, or onset of new opacifications) by inspecting the subtraction images and the two original images side-by-side. In addition, the quality of the subtraction images, an indication of the performance of the registration algorithm, was scored on a 1-5 scale with 5 being the best. Performance was evaluated using free-response operating characteristic analysis.

## RESULTS

In total, 92 relevant changes were annotated by the experienced radiologist in the test set. The quality of the subtraction images was rated high: only five subtraction images (4%) had a rating lower than 4. FROC analysis showed that the automatic system detected 71% of all relevant change at an average of 2.0 false positives per scan.

## CONCLUSION

Automatic detection of interval changes between low-dose CT images is feasible and may be of additional value when reading follow-up scans in a lung cancer screening setting.

## CLINICAL RELEVANCE/APPLICATION

Detection of interval changes between consecutive low-dose CT images is crucial in lung cancer screening. Visual comparison of CT

scans is tedious and prone to errors and may therefore benefit from automatic indications of interval changes.

### **SSQ20-08 Automated Detection of Mass-like, Non-mass-like and Focus Breast Cancer Lesions Visible in False-negative Screening DCE-MRI**

Thursday, Dec. 3 11:40AM - 11:50AM Location: S404AB

#### **Participants**

Albert Gubern-Merida, PhD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose  
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#### **PURPOSE**

Breast cancer lesions are regularly overlooked or misinterpreted in breast MRI screening due to lesion appearance suggesting benign disease, extensive background enhancement or fatigue and lack of experience analyzing 4D data. In this study, we evaluate the performance of an automated computer-aided detection (CAD) system to detect mass-like, non-mass-like and focus breast cancer lesions that were, in retrospect, visible on earlier screening MRIs but only detected in a subsequent scans.

#### **METHOD AND MATERIALS**

Between 2003 and 2013, we identified 24 prior-negative MRI scans (BI-RADS 1/2) with 24 breast cancers (10 mass-like, 8 non-mass-like and 6 foci) in a MRI screening program. Cancers were detected by radiologists at the following screening round. Additionally, 120 normal scans were collected from the same MRI screening program from different women without history of breast cancer or breast surgery. A previously validated fully automated CAD system was applied to this dataset to detect malignant lesions. The system corrects for motion artifacts and segments the breast. Subsequently, lesion candidates are detected using relative enhancement and texture features to characterize breast cancer lesions. The final classification is performed using region-based morphological and kinetics features computed on segmented lesion candidates. The detection performance was evaluated using free-response receiver operating characteristic analysis and bootstrapping. A CAD finding was considered a true positive when its center was inside a lesion annotation. The false positive rate (FP/case) was determined on the normal cases.

#### **RESULTS**

At 4 FP/case, the sensitivity for detecting mass-like and non-mass-like lesions in prior-negative scans was 0.50 (95% confidence interval 0.17-0.83) and 0.85 (0.50-1.00), respectively. At the same FP/case, the CAD system did not detect focus breast cancer lesions.

#### **CONCLUSION**

A CAD system was able to automatically detect 50% and 85% of mass-like and non-mass-like enhancement lesions that were missed in screening with MRI, respectively. Further improvement is required to detect focus lesions. The integration of such a system in clinical practice might aid radiologists to avoid screening errors.

#### **CLINICAL RELEVANCE/APPLICATION**

Automated lesion detection in breast MRI can facilitate breast cancer screening and reduce reading errors.

### **SSQ20-09 Optimisation of the Selection of Women with an Increased Risk of a Masked Tumour for Supplementary Screening**

Thursday, Dec. 3 11:50AM - 12:00PM Location: S404AB

#### **Participants**

Katharina Holland, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose  
Carla H. van Gils, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Software support, Matakina Technology Limited  
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#### **PURPOSE**

The sensitivity of mammograms is low for women with dense breasts, because cancers may be masked by dense tissue. In this study we investigate methods to identify women with density patterns associated with a high masking risk. Four methods based on quantitative volumetric breast density analysis are compared to an area based density measure.

#### **METHOD AND MATERIALS**

We used the last negative screening mammograms of 87 women who subsequently presented an interval cancer (IC), and 870 randomly selected normal screening exams from women without cancer as controls. Volumetric breast density maps (VBDMs) were computed using software provided by Matakina (Wellington, New Zealand). These maps provide the dense tissue thickness for each pixel location. We used the VBDMs to compute four masking measures: 1) Volume of glandular tissue (VGT), 2) Percent dense volume (PDV), 3) Percent area where dense tissue thickness exceeds 1cm (PA1), and 4) Possibility that there is a tumor, with diameter  $t$ , at a location with dense tissue thickness  $d$ , normalized to the breast area, taking into account the size distribution of screen detected cancers (PT). In addition we determined percentage dense area (PDA) after classifying pixels automatically in dense and non-dense classes using a random forest classifier. Methods were applied to MLO views and then averaged per exam. For each method, we selected cases with the highest masking measure by thresholding and computed the fraction of ICs as a function of the fraction of controls selected. Furthermore we computed the ratio between IC with supplemental screening offer and the supplemental screening rate.

#### **RESULTS**



The highest ratio between IC and supplemental screening rate has been observed for PA1 with a screening rate of 5% and a sensitivity of almost 20%. For screening rates above 20%, the highest response of IC can be observed when using PA1 and PT for stratification.

#### **CONCLUSION**

We showed that the different breast density measures are suited for stratification. A careful choice of the stratification criteria is necessary depending on the number of women that one is willing to offer supplemental screening.

#### **CLINICAL RELEVANCE/APPLICATION**

To make supplemental breast cancer screening feasible and cost efficient, it is necessary to have a high response in the target group while the selected women in the overall screening population remains low.

SSQ05

## Chest (Diffuse Lung Disease/Functional Imaging)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S404CD

**CH** **BQ** **CT** **MR**

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

**FDA** Discussions may include off-label uses.

### Participants

Yoshiharu Ohno, MD, PhD, Kobe, Japan (*Moderator*) Research Grant, Toshiba Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Terumo Corporation; Research Grant, Fuji Yakuhin Co, Ltd; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Guerbet SA; Hiroto Hatabu, MD, PhD, Boston, MA (*Moderator*) Research Grant, Toshiba Corporation Research Grant, AZE, Ltd Research Grant, Canon Inc

### Sub-Events

#### SSQ05-01 Distribution and Associated High-Resolution CT findings Predict Survival in Chronic Hypersensitivity Pneumonitis

Thursday, Dec. 3 10:30AM - 10:40AM Location: S404CD

### Participants

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Evans R. Fernandez Perez, Denver, CO (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

It is unknown if the presence of air-trapping and disease distribution on chest CT, which may be a clue to the diagnosis, predicts mortality among patients with chronic hypersensitivity pneumonitis (CHP).

### METHOD AND MATERIALS

The earliest CT chest scans from subjects with HP were scored. Fibrotic HP on CT was defined as presence of reticulation with associated traction bronchiectasis and/or bronchiolectasis. The predominant zonal and axial distribution of lung disease, the presence or absence as well as total percentage of lung involvement (to the nearest 5%) for air-trapping was scored. The most likely diagnosis with level of confidence (possible, probable, or definite) was also determined. A Cox proportional hazards (PH) model was used to identify independent predictors in time-to death analysis.

### RESULTS

Of 82 subjects, 60 (73%) had fibrotic HP, and 22 (27%) had non-fibrotic HP on chest CT. The most common patterns were HP (43, 52%), UIP (19, 23%), NSIP (11, 13%), and other (9, 10%). Compared to other CT patterns, the HP pattern was most often zonally diffuse or upper and axially diffuse or peripheral ( $p < 0.01$ ). Compared with survivors, patients who died had lower FVC% predicted, were more likely to have pulmonary fibrosis, and were less likely to have ground-glass opacity on CT. In a Cox PH model, the presence of UIP pattern of fibrosis, axially diffuse disease, and absence of air-trapping/mosaic perfusion were independent predictors of survival (Hazard ratios 2.82 [p-value 0.02], 2.46 [p-value 0.01], and 0.39 [p-value 0.01]; respectively).

### CONCLUSION

Chest CT has prognostic value in the setting of CHP.

### CLINICAL RELEVANCE/APPLICATION

Chest CT may be a valuable biomarker in HP, aside from diagnosis and follow-up.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Jonathan H. Chung, MD - 2013 Honored Educator

#### SSQ05-02 Prevalence of Pulmonary Fibrosis in Asymptomatic 1st Degree Relatives of Patients with Familial Pulmonary Fibrosis (FPF)

Thursday, Dec. 3 10:40AM - 10:50AM Location: S404CD

### Participants

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David Schwartz, Denver, CO (*Abstract Co-Author*) Nothing to Disclose

David A. Lynch, MBBCh, Denver, CO (*Abstract Co-Author*) Research support, Siemens AG; Scientific Advisor, PAREXEL International Corporation; Consultant, Boehringer Ingelheim GmbH; Consultant, Gilead Sciences, Inc; Consultant, F. Hoffmann-La Roche Ltd; Consultant, Veracyte, Inc;

## PURPOSE

The purpose of this study was to determine the prevalence and pattern of HRCT pulmonary fibrosis in asymptomatic 1st degree relatives of patients with FPF.

## METHOD AND MATERIALS

HRCT scans of 250 1st degree relatives of patients with FPF were scored by two thoracic radiologists using a variation of a sequential reading method previously described (Washko GR, et al. N Engl J Med. 2011 Mar 10;364(10):897-906). CT scans were scored as no, equivocal for, suspicious for, or definite pulmonary fibrosis. Presence of honeycombing and ground-glass opacity as well as extent of disease to the nearest 10% was also scored. HRCT diagnosis was also collected with level of confidence (possible, probable, definite).

## RESULTS

222 of the 250 CT scans were considered technically adequate. In 15.3% (34/222), pulmonary fibrosis was present (definite or probable). In an additional 3.2% (7/222), presence of pulmonary fibrosis was scored as equivocal. In those with pulmonary fibrosis, an average of 6% (+/-7%) of the lung was involved. Honeycombing in these subjects was present in 14.7% (5/34) while ground-glass opacity was present in 23.5% (8/34). The extent of honeycombing was very small and on average closest to 0% in all subjects with honeycombing. The extent of ground-glass opacity was on average 9% (+/-8%). A high confidence pattern was identified in 38.2% (13/34) of subjects with pulmonary fibrosis: 6 UIP, 3 NSIP, 2HP, and 1 asbestosis.

## CONCLUSION

Pulmonary fibrosis is common in asymptomatic relatives of patients with FPF.

## CLINICAL RELEVANCE/APPLICATION

HRCT screening of asymptomatic relatives of patients with FPF should be considered.

## Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Jonathan H. Chung, MD - 2013 Honored Educator

## SSQ05-03 Prediction of Survival with Baseline Extent and 1-year Change of Regional Disease Patterns at Thin Section CT in Idiopathic Pulmonary Fibrosis

Thursday, Dec. 3 10:50AM - 11:00AM Location: S404CD

### Participants

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Sang Min Lee, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Namkug Kim, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Stockholder, Coreline Soft, Inc

Jin Woo Song, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To know if the baseline extent and 1-year change of regional disease patterns at thin-section CT (TSCT), which is measured with texture-based automated quantification system, can predict survival of idiopathic pulmonary fibrosis (IPF)

## METHOD AND MATERIALS

Total 194 IPF patients (M:F = 153:41; 63.3 ± 7.8yrs) with TSCT scans at the time of diagnosis and 1 year after were included. Mean follow-up period of survival was 36.0 ± 18.9 months. Using in-house, texture-based automated system, the area percent of five regional disease patterns, including ground glass opacity (GGO), reticular opacity (RO), honeycomb (HC), emphysema (EM) and consolidation (CON) were quantified. The area percent of abnormal lung (AbN) and fibrosis (FIB) were calculated. The survival analyses were performed by constructing Kaplan-Meier disease-free survival curves. The association of baseline extent and 1-year change of TSCT measures with survival was assessed with Cox proportional hazards regression. Both univariable and multivariable analyses including age, sex, smoking, baseline and change of FVC%pred, DLCO%pred and SpO2% were performed.

## RESULTS

Measured relative extents of AbN, HC, GGO, CON, EM, RO and FIB at baseline and 1-year follow-up TSCT were as follows; baseline: 43.0% ± 17.1, 7.0 ± 6.7, 12.3 ± 11.9, 2.9 ± 1.3, 3.9 ± 5.5, 16.8 ± 9.8, 23.9 ± 12.3; follow-up: 45.3 ± 19.5, 7.2 ± 7.6, 13.8 ± 11.6, 3.2 ± 1.5, 3.6 ± 5.6, 17.6 ± 11.6, 24.8 ± 14.4, respectively. Survival analysis indicate that disease-free survival of patients with higher baseline extent of AbN, HC, RO, FIB (cut-off value 35%, 10%, 25%, 20%, respectively) and increased extent of AbN, HC, RO, FIB at follow-up TSCT (cut-off value 5%) were significantly shorter than in patients with lower baseline extent and stable or decreased extent of those regional patterns (all p<0.001). Univariable analysis revealed that baseline FVC%pred, DLCO%pred, SpO2%, AbN, HC, RO, FIB, change of AbN, HC, RO, FIB were predictive of survival, After adjustment, the baseline extent of RO and change in extent of AbN were predictive of survival.

## CONCLUSION

The baseline extent and 1-year change of regional disease patterns at TSCT, which is measured with texture-based automated quantification system, can predict survival of IPF patients.

## CLINICAL RELEVANCE/APPLICATION

The baseline extent and change of regional disease patterns quantified with texture-base automated quantification system is useful in predicting survival of IPF patients.

### SSQ05-04 Parallel Bands of Lung Involvement Along the Direction of Ribs: A New Sign of Systemic Sclerosis on Volume-rendered Computed Tomography of the Chest

Thursday, Dec. 3 11:00AM - 11:10AM Location: S404CD

#### Participants

Hanan Sherif, MD, Doha, Qatar (*Abstract Co-Author*) Nothing to Disclose  
Ahmed-Emad Mahfouz, MD, Doha, Qatar (*Abstract Co-Author*) Nothing to Disclose  
Maysa A. Mohamed, MBBS, Doha, Qatar (*Abstract Co-Author*) Nothing to Disclose  
Ahmed Sayedin, MBBCh, Doha, Qatar (*Presenter*) Nothing to Disclose

#### PURPOSE

To differentiate between systemic sclerosis-related interstitial lung disease and usual interstitial pneumonia on volume-rendered computed tomography (CT) of the chest.

#### METHOD AND MATERIALS

The multi-detector CT examinations of the chest of 50 patients with systemic sclerosis and 50 patients with usual interstitial pneumonia have been post-processed to obtain volume-rendered images of the lungs. On these images, normally aerated lung parenchyma has been encoded blue and increased attenuation of lung parenchyma has been encoded white. The images have been randomized and provided to an experienced radiologist to note the presence or absence of parallel bands of increased attenuation of the lung parenchyma along the direction of the ribs (the parallel-band sign). Statistical analysis has been done by the chi-square test.

#### RESULTS

The parallel-band sign has been seen in 32 patients with systemic sclerosis-associated interstitial lung disease and in none of the patients with usual interstitial pneumonia. The parallel-band sign has sensitivity of 64.0%, specificity of 100.0%, positive predictive value of 100.0%, negative predictive value of 73.5%, and accuracy of 82.0% for the diagnosis of systemic sclerosis-associated interstitial lung disease on volume-rendered CT of the chest.

#### CONCLUSION

Lung involvement in systemic sclerosis-related interstitial lung disease may take the characteristic distribution of parallel bands at the surface of the lungs along the direction of the ribs. The parallel-band sign differentiates systemic sclerosis-related interstitial lung disease from usual interstitial pneumonia with high specificity on volume-rendered CT of the chest.

## CLINICAL RELEVANCE/APPLICATION

The use of the parallel-band sign may help differentiate systemic sclerosis-associated interstitial lung disease from usual interstitial pneumonia, particularly if the interstitial lung disease precedes other manifestations of systemic sclerosis such as skin involvement, cardiac disease, or esophageal dilatation.

### SSQ05-05 Regional Variation in Ventilation in the Asthmatic Human Lungs Using Magnetic Resonance Imaging and Computed Tomography

Thursday, Dec. 3 11:10AM - 11:20AM Location: S404CD

#### Participants

Wei Zha, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Stan Kruger, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Robert V. Cadman, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
David Mummy, MS, MBA, Madison, WI (*Presenter*) Nothing to Disclose  
Nizar Jarjour, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Ronald L. Sorkness, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Scott K. Nagle, MD, PhD, Madison, WI (*Abstract Co-Author*) Stockholder, General Electric Company Research Consultant, Vertex Pharmaceuticals Incorporated  
Sean B. Fain, PhD, Madison, WI (*Abstract Co-Author*) Research Grant, General Electric Company Research Consultant, Marvel Medtech, LLC

#### PURPOSE

To investigate regional patterns of ventilation abnormalities in asthmatics with both automated and manual methods.

#### METHOD AND MATERIALS

A total of 83 asthmatic subjects (normal/moderate/severe: n=14/49/20) underwent hyperpolarized (HP) <sup>3</sup>He magnetic resonance imaging (MRI), spirometry, and computed tomography (CT). The right and left lungs were segmented from proton MRI using a region-growing algorithm written in MATLAB and further separated into the lung lobes (right upper-RUL, middle-RML and lower-RLL; left upper-LUL and lower-LLL) by a deformable registration to lobar segmentation derived from CT (VIDA Diagnostics, IA). <sup>3</sup>He was registered to proton using a rigid registration method. Ventilation defects were identified independently using both manual segmentation and an automated approach which corrected for B1 inhomogeneity, excluded pulmonary vasculature and determined defects adaptively. A linear mixed-effects model was used to perform the pairwise comparison of percent defect volume (PDV) amongst lobes. Spearman correlation was used to evaluate the association between PDV and spirometry. A p<0.05 is considered significant.

#### RESULTS

The automated defect quantification took ~3min versus 20min per study for manual segmentation. The two methods yielded similar whole lung PDV (p=0.12). The whole lung PDV measured by both methods correlated inversely with the percent predicted forced

expiratory volume in 1 second (% FEV1) (manual/automated:  $\rho = -0.41$ ,  $p = 0.0002$ / $\rho = -0.24$ ,  $p = 0.040$ ) and % FEV1 over forced vital capacity ( $\rho = -0.46$ ,  $p < 0.0001$ / $\rho = -0.32$ ,  $p = 0.0045$ ). Both methods found PDV was significantly larger in the RML (automated:  $8.21 \pm 13.64\%$ ) than all other lobes (all  $p < 0.013$ ). The RUL ( $5.52 \pm 8.83\%$ ) was less ventilated than the RLL ( $3.55 \pm 5.24\%$ ) and LLL ( $2.62 \pm 3.82\%$ ) with  $p < 0.047$ . The automated method also suggested a more defected RUL than LUL ( $3.26 \pm 4.76\%$ ) with  $p = 0.011$  whereas the difference was not significant by manual measurements.

## CONCLUSION

Compared to manual assessment, the automated approach provides comparable PDV measurements and similar association to spirometric measures. Both methods suggest the RML is most affected in asthmatic lungs and that the RUL is measurably more defected than RLL and LLL.

## CLINICAL RELEVANCE/APPLICATION

The automated defect quantification can facilitate the application of HP 3He MRI as a potential tool for guiding bronchoscopic assessment of cellular and molecular markers of asthma progression.

### SSQ05-06 Lobar Analysis of Hyperpolarised Xenon MR Lung Imaging (Xe-MRI) in Chronic Obstructive Pulmonary Disease (COPD)

Thursday, Dec. 3 11:20AM - 11:30AM Location: S404CD

#### Participants

Tahreema N. Matin, MBBS, Oxford, United Kingdom (*Presenter*) Nothing to Disclose  
Mitchell Chen, DPhil, MBBS, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Xiaojun Xu, MSc, DPhil, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Tom Doel, DPhil, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Najib Rahman, MSc, DPhil, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Vicente Grau, PhD, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Annabel Nickol, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Fergus V. Gleeson, MBBS, Oxford, United Kingdom (*Abstract Co-Author*) Consultant, Alliance Medical Limited; Consultant, Blue Earth Diagnostics Limited; Consultant, Polarean, Inc;

#### PURPOSE

To determine lobar ventilation and apparent diffusion coefficient (ADC) values acquired using hyperpolarised xenon MR lung imaging (Xe-MRI) in subjects with chronic obstructive pulmonary disease (COPD), and to correlate these with quantitative CT (QCT) and pulmonary function tests (PFTs).

#### METHOD AND MATERIALS

Eighteen patients with COPD (stage II - IV GOLD criteria classification) underwent Xe-MRI at 1.5T, QCT and PFTs. Whole lung and lobar Xe-MRI parameters were obtained using semi-automated segmentation of multi-slice Xe-MRI ventilation images and Xe-MRI diffusion-weighted images ( $b = 20.855 \text{ sec/cm}^2$ ) following co-registration to CT using in-house software. Percentage predicted PFT results were established. Whole lung and lobar QCT-derived emphysema was calculated from percentage of lung tissue with density of  $< -950 \text{ HU}$ . Pearson's correlation coefficients were used to evaluate the relationship between imaging measures and PFTs.

#### RESULTS

Lobar Xe-MRI percentage ventilated volume and lobar Xe-MRI average ADC showed significant correlation with lobar QCT percentage emphysema ( $r = 0.61$ ,  $P < < 0.001$  and  $r = 0.72$ ,  $P < < 0.001$  respectively). Whole lung Xe-MRI average ADC showed significant correlation with the PFTs: percentage predicted transfer factor of the lung of carbon monoxide (TLCO) ( $r = -0.69$ ,  $P < 0.03$ ) and percentage predicted functional residual capacity (FRC) ( $r = 0.65$ ,  $P < 0.007$ ). Whole lung QCT percentage emphysema showed a similar significant correlation with percentage predicted TLCO ( $r = -0.71$ ,  $P < < 0.001$ ) and percentage predicted FRC ( $r = 0.48$ ,  $P < 0.05$ ).

## CONCLUSION

This is the first study to generate lobar analysis of Xe-MRI ventilation and ADC. The excellent correlation of whole lung Xe-MRI average ADC with PFTs and lobar Xe-MRI derived measures with lobar QCT percentage emphysema provide supportive evidence for employment of this technique in patients with COPD. This is particularly relevant for those undergoing regional treatments, where Xe-MRI has the potential to accurately guide treatment options or predict post-treatment lung function.

## CLINICAL RELEVANCE/APPLICATION

The potential clinical value of Xe-MRI regional lung assessment is becoming increasingly relevant with the possibility of regional lung treatments e.g. lung volume reduction surgery, endobronchial valve placement and radiotherapy. The excellent correlation of Xe-MRI with QCT-derived measures of COPD and PFTs suggests it may be of value in patients considered for these treatments.

### SSQ05-07 MR Perfusion Parameters and Apparent Diffusion Coefficient in Lung Cancer: Relation to Microvessel Density Based on Surgical Specimen

Thursday, Dec. 3 11:30AM - 11:40AM Location: S404CD

#### Participants

Chin A Yi, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Jae-Hun Kim, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hyeok-Jun Won, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Microvessel density is a direct biomarker of tumor angiogenesis. Perfusion parameters of dynamic contrast-enhanced MRI (DCE-MRI) and apparent diffusion coefficient (ADC) of diffusion-weighted MR imaging (DWI) can be measured as a quantitative, non-invasive, and repetitive method for the estimation of tumor angiogenesis in the lung cancer. The purpose of this study was to correlate MR perfusion parameters and ADC with microvessel density in lung cancers patients who underwent surgical resection.

#### METHOD AND MATERIALS

Ninety three patients (53 men, 40 women; age range, 40-79 years) with non-small cell lung cancers underwent diffusion-weighted and dynamic contrast-enhanced MR imaging before surgery. Surgical specimens were obtained and microvessel density was measured with immunohistochemistry staining for CD 31. Perfusion parameters (Ktrans; volume transfer coefficient, ve; fraction of extravascular extracellular space, vp; fraction of plasma space, T0; the time lag between bolus arrival times of arterial input function and tissue concentration) and ADC were measured and compared with quantitative histologic microvessel density by using the Pearson correlation test.

## RESULTS

The significant positive correlations were found between microvessel density and Ktrans ( $r=0.22$ ,  $P=0.03$ ) and vp ( $r=0.29$ ,  $P < .01$ ). An inverse correlation was found between T0 and microvessel density ( $r=-0.34$ ,  $P < .01$ ), whereas no significant correlation was found between ADC and microvessel density.

## CONCLUSION

Perfusion parameter such as Ktrans, ve, and T0 showed significant correlation with microvessel density in lung cancers, whereas no correlation was found between ADC and microvessel density.

## CLINICAL RELEVANCE/APPLICATION

Perfusion parameter such as Ktrans, ve, and T0 may play a role as indirect biomarkers indicating the extent of microvessel density in lung cancers.

## SSQ05-08 Pulmonary Perfusion Phase Imaging using Self-Gated Fourier Decomposition MRI Reveals Perfusion Inhomogeneities in Patients with Cystic Fibrosis

Thursday, Dec. 3 11:40AM - 11:50AM Location: S404CD

### Participants

Simon Veldhoen, MD, Wurzburg, Germany (*Presenter*) Nothing to Disclose  
Daniel Stab, St Lucia, Australia (*Abstract Co-Author*) Nothing to Disclose  
Andreas M. Weng, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Andreas Kunz, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Andre Fischer, DIPLPHYS, PhD, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Clemens Wirth, MD, Wuerzburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Helge Hebestreit, MD, Wuerzburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Thorsten A. Bley, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Herbert Koestler, PhD, Wuerzburg, Germany (*Abstract Co-Author*) Research support, Siemens AG

## PURPOSE

Fourier Decomposition (FD) MRI provides site-resolved functional lung imaging without application of contrast media. Perfusion and ventilation-weighted images are reconstructed using a Fourier analysis of a non-triggered time series of morphologic lung images. In this work, we demonstrate that perfusion-weighted data also carries information regarding the pulmonary perfusion phase.

## METHOD AND MATERIALS

Lung perfusion measurements were performed using SENCEFUL, an advancement of the FD technique, obtaining morphologic image series by cardiac and respiratory self-navigation of data sampled in quasi-random fashion. Signal variations over the cardiac cycle allow for determining perfusion-weighted images (perfusion amplitude) and the perfusion phase, which indicates the phase shift in the lungs in relation to a reference voxel in a central vessel (e.g. pulmonary trunk). Pulmonary perfusion amplitude and phase measurements on 3 volunteers and 3 cystic fibrosis patients were performed on a 1.5T system. A 2D FLASH sequence providing a DC signal acquisition for self-navigation was used.

## RESULTS

Perfusion amplitude maps of the healthy subjects revealed homogeneous lung perfusion. In the perfusion phase maps, the perfusion-induced signal changes exhibited similar behavior in all lung parts. In contrast, the maps of the cystic fibrosis patients showed areas with reduced perfusion and a significantly higher phase dispersion. The attached image example of a 27 year old cystic fibrosis patient shows reduced perfusion e.g. in the upper lobes and the perfusion phase map reveals an higher phase dispersion when compared to the healthy volunteer. Similar results were found in the other examined volunteers and cystic fibrosis patients.

## CONCLUSION

Signal intensities in lung MRI are pulsatile as a function of the cardiac triggered inflow. While a balanced perfusion phase in healthy volunteers indicates a homogeneous pulse wave velocity throughout the lungs, results in patients with cystic fibrosis show regionally varying delays.

## CLINICAL RELEVANCE/APPLICATION

Based on a time series' FD, the maps describe a new contrast in pulmonary MRI. First measurements revealed that perfusion phase maps of cystic fibrosis patients differ from those of healthy subjects. Hence, the perfusion phase may contain valuable diagnostic information. Detailed examination of the diagnostic capabilities of FD based perfusion phase MRI is subject to future work.

## SSQ05-09 Functional Evaluation of Chronic Lung Allograft Dysfunction with Novel Computed Tomography Lung Deformation Algorithms

Thursday, Dec. 3 11:50AM - 12:00PM Location: S404CD

### Participants

Miho Horie, MSc, Toronto, ON (*Presenter*) Research Grant, Toshiba Corporation  
Tomohito Saito, MD, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose  
Joanne Moseley, Toronto, ON (*Abstract Co-Author*) Royalties, RaySearch Laboratories AB;  
Shafique Keshavjee, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

## **PURPOSE**

Lung transplantation is the destination therapy for end stage chronic lung disease. Chronic lung allograft dysfunction (CLAD) limits the 5-year survival after lung transplantation (Tx). It is important to diagnose and distinguish the CLAD subtypes: Bronchiolitis Obliterans Syndrome (BOS) and Restrictive Allograft Syndrome (RAS). CLAD diagnosis with conventional techniques is limited, deformable registration provides qualitative and quantitative assessment of focal and global lung function. The purpose of this study is to determine the utility of using deformable registration CT data in the diagnosis of CLAD.

## **METHOD AND MATERIALS**

A retrospective study of 30 patients post bilateral Tx followed with PFT and low dose lung CT (conventional tests) scheduled every 3mths. The study cohort had confirmed diagnosis, based on conventional tests and pathology: No-CLAD (n=10); BOS (n=10); RAS (n=10). The CT data was assessed qualitatively and quantitatively using finite element based image registration software (MORFEUS) to document changes in lung deformation between baseline and disease onset. Surface vector analysis was performed and indicated expansion (+) or contraction (-) of regional lung volume; the mean and percentage change for inward and outward vectors was compared using the Mann-Whitney U test.

## **RESULTS**

Qualitative analysis: Upper lobe deformation; No-CLAD 20% (2/10); BOS 20% (2/10) and RAS 70% (7/10). Quantitative analysis: mean vector change from baseline (% change from baseline); for the right (R) and left (L) lungs. No-CLAD: R= +4.0mm (55%); L= +3.2mm (59%). BOS: R= +3.8mm (61%); L= +3.4mm (57%). RAS: R= -8.6mm (71%); L= -9.9mm (74%).

## **CONCLUSION**

Deformable lung registration can quantitatively detect and distinguish between No-CLAD/BOS and RAS.

## **CLINICAL RELEVANCE/APPLICATION**

Lung deformation analysis is a promising technique in evaluating the subtypes of CLAD and in assessing regional change when conventional techniques are limited.

RCA52

## National Library of Medicine: Online Images and Datasets: Options for Research and Presentations (Hands-on)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S401AB



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

### Participants

Holly Ann Burt, MLIS, Chicago, IL (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify freely available online image databases and data archives including those with online case studies. 2) Use basic searching skills across a variety of databases. 3) Locate copyright options for literature images and radiology datasets.

### ABSTRACT

In this hands-on workshop, explore radiographic images and data available online. The National Library of Medicine (NLM) is only one of many agencies which support freely available online image databases and data archives. Topics include searching for journal images, identifying copyright options, and finding case studies or images specifically for patients and families. Use search engines and portals offering a radiology option; discover public data archives and how to search and access datasets; and identify available imaging tools. Learn which databases may be the best starting point for your research.

**Handout:** [Holly Ann Burt](#)

<http://abstract.rsna.org/uploads/2015/15004109/2015onlinedatabasesRSNA.pdf>



RCB52

## Using Keynote: An Alternative to Power Point (Hands-on)

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



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

### Participants

Shawn D. Teague, MD, Indianapolis, IN (*Presenter*) Stockholder, Apple Inc

### LEARNING OBJECTIVES

1. Modify the master slides used in a template. 2. Change the aspect ratio for a presentation from 4:3 to 16:9. 3. Utilize movies in a presentation. 4. Utilize the remote control feature in Keynote with a mobile device.

SSQ19

## Physics (CT VII-Image Quality I)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S403B

**CT** **PH** **SQ**

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

**FDA** Discussions may include off-label uses.

### Participants

Katsuyuki Taguchi, PhD, Baltimore, MD (*Moderator*) Research Grant, Siemens AG  
Tinsu Pan, PhD, Houston, TX (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ19-01 Atypical Head CT Artifact-Potential for Misdiagnosis

Thursday, Dec. 3 10:30AM - 10:40AM Location: S403B

### Participants

Raja Subramaniam, PhD, Brooklyn, NY (*Abstract Co-Author*) Nothing to Disclose  
Jo-Ann Provencher, MS, New York, NY (*Presenter*) Nothing to Disclose  
Idoia Corcuera-Solano, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Luke C. Gerke, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Serge Sicular, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Lawrence N. Tanenbaum, MD, New York, NY (*Abstract Co-Author*) Speaker, General Electric Company; Speaker, Bracco Group; Speaker, Bayer AG; Speaker, Siemens AG; Speaker, Guerbet SA  
Bradley N. Delman, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### Background

The accurate diagnosis of strokes is crucial as misdiagnosis can lead to administration of unnecessary treatment, patient stress and pointless follow up scans. The timely identification of artifacts is crucial to the limitation of misdiagnosis. We reported a rare artifact on head CT that led to 6 misdiagnosis before it was identified. Our purpose is to present this artifact manifestation to allow early detection to avoid potential clinical misdiagnosis.

### Evaluation

This artifact occurred on a GE LightSpeed VCT XT CT and exhibited subtle areas of decreased attenuation mostly involving the left frontal cortex and periventricular white matter, the imaging appearance suggestive of ischemia/infarct. In all cases, a 2nd CT or a brain MR scan was performed, refuting the presence of acute ischemia. The possibility of the artifact was pointed out after several scans provided similar diagnosis on asymptomatic patients with unremarkable follow up CT or MR imaging. The daily QA phantom was scanned and analyzed, revealing the presence of low attenuation streaks, mostly located in the upper right quadrant.

### Discussion

The artifact was caused by air leak into the oil used for cooling the X-ray tube. GE VCT has the heat exchanger located outside the tube housing. Oil is circulated between housing and the heat exchanger via a hose, attached using 'quick disconnect' connector. This mechanical part, over periods of use, can allow air to leak in. A leaked air bubble located in the tube port created a region of low attenuation, which was translated as dark streaks in our images. The problem was corrected after fresh oil was cycled through the cooling system.

### Conclusion

Our aim was to educate on the possibility and visual appearance of this artifact, its cause, and corrective actions necessary to rectify the situation. This is an artifact that seems germane to CT units that have the heat exchanger isolated from the X-ray tube. Prompt discovery of this artifact would prevent unnecessary patient anxiety, administration of costly and time consuming additional scans (and associated increased radiation dose) and administration of unnecessary and potentially harmful treatments.

#### SSQ19-02 Estimation of Bias Corrections in Observer Model Performance Metrics for Accurate Comparisons of CT Image Quality

Thursday, Dec. 3 10:40AM - 10:50AM Location: S403B

### Participants

Christopher P. Favazza, PhD, Rochester, MN (*Presenter*) Nothing to Disclose  
Lifeng Yu, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose  
Shuai Leng, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose  
Kenneth A. Fetterly, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose  
Cynthia H. McCollough, PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, Siemens AG

### PURPOSE

To accommodate the increasing adoption of iterative image reconstruction techniques, observer models have been proposed to evaluate CT image quality across spectra of scanners, protocols, tasks, and reconstruction methods. A major limitation of such models is the requirement of a large number of images (N) to train the model, as bias in performance increases with reducing N. The aim of this study was to evaluate a method to correct for finite sampling bias in model performance for an object detection task in real CT images and to investigate observer model performance bias as a function of both dose and N.

### METHOD AND MATERIALS

A computer-generated, simulated, multi-phase, multi-contrast (MPC) model was employed to evaluate the detectability of a 2 mm diameter

A previously validated channelized Hotelling observer (CHO) model was employed to evaluate the detectability of a 3 mm diameter circular object. The object was submerged in a 35x 25 cm<sup>2</sup> iodine-doped water filled phantom, yielding -15 HU object contrast. The phantom was scanned with 3 different dose levels (quantified by CTDI<sub>vol</sub>): 3.6, 7.2, and 21.8 mGy. For each dose level, the phantom was scanned 100 times with and without the object present. A bias-corrected CHO detectability index (bc-DI) was derived from DIs calculated with varied numbers of training images (N). Specifically, bc-DI values were determined from intercept values of linear fits of DI versus 1/N for all dose levels. Additionally, bc-DI values were derived from limited datasets: 70, 80, and 90 total images and compared with bc-DI values obtained from the full 100 image datasets.

## RESULTS

Estimates of bc-DI values revealed variable bias in DI as a function of dose. DI values calculated for images acquired with higher dose levels yielded greater absolute bias as compared to the DI values calculated from image acquired with lower dose levels. For all dose levels, estimates of bc-DI values derived from reduced datasets were consistent; percent deviations from the value derived from N=100 were  $\leq 7\%$ .

## CONCLUSION

The use of a finite number of training images leads to bias in the CHO's performance that varies with dose and number of training images. Through the methodology employed here, it is possible to estimate reliable bc-DI values with reduced number of training images.

## CLINICAL RELEVANCE/APPLICATION

Observer models are being widely investigated to evaluate and compare CT image quality. Variability in model performance bias should be well-understood for accurate image quality comparisons.

## SSQ19-03 A Task-Based kV-mAs Optimization Framework for Both Linear and Nonlinear CT Systems

Thursday, Dec. 3 10:50AM - 11:00AM Location: S403B

### Participants

Daniel Gomez-Cardona, Madison, WI (*Presenter*) Nothing to Disclose

Ke Li, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

Meghan G. Lubner, MD, Madison, WI (*Abstract Co-Author*) Grant, General Electric Company; Grant, NeuWave Medical, Inc; Grant, Koninklijke Philips NV

Perry J. Pickhardt, MD, Madison, WI (*Abstract Co-Author*) Co-founder, VirtuoCTC, LLC; Stockholder, Celectar Biosciences, Inc; Research Consultant, Bracco Group; Research Consultant, KIT ; Research Grant, Koninklijke Philips NV

Guang-Hong Chen, PhD, Madison, WI (*Abstract Co-Author*) Research funded, General Electric Company; Research funded, Siemens AG

## PURPOSE

Zero-frequency metrics such as the contrast-to-noise ratio (CNR) are commonly used for the optimal selection of tube voltage (kV) and tube current-rotation time product (mAs) in CT. However, these metrics are invalid for nonlinear CT systems such as those using model based iterative reconstruction (MBIR) algorithms. This study reports a new task-based framework to optimize the selection of kV and mAs for both linear and nonlinear CT systems.

## METHOD AND MATERIALS

Using the frequency-dependent modern signal detection theory, kV/mAs optimization was formulated as a constrained minimization problem: choose the kV/mAs that minimizes radiation dose while maintaining the clinically prescribed detection performance. To experimentally solve this constrained optimization problem, exhaustive measurements of the detectability index ( $d'$ ) for a hepatic lesion detection task were performed with a fixed rotation time at 15 different mA levels (25 to 700) and at 4 kV levels (80 to 140) in an anthropomorphic phantom; these values were used to generate an iso-detectability contour map. Similarly, an iso-dose contour map was generated using the measured doses for each kV/mAs combination and was then overlaid with the iso-detectability map. Thus, for a prescribed detectability level ( $d'_p$ ), the optimal kV-mA combination could be determined as the intersection between the  $d'_p$  contour and the minimum dose contour. These results were then validated with an in vivo animal study.

## RESULTS

For a prescribed detectability level of  $d'=16$ , the kV-mAs combinations (followed by CTDI<sub>vol</sub> dose levels (mGy) in parentheses) on the measured iso-detectability contour of MBIR were 80-150 (3.8), 100-140 (6.6), 120-150 (11.3), and 140-160 (17.2). Thus, the optimal kV-mA was 80-150 (3.8) for MBIR; in comparison, the optimal kV-mA for FBP was 100-500 (23.7 mGy). These results provided image quality and dose reduction factors in our in vivo study and were consistent with the phantom results.

## CONCLUSION

A new method to optimize kV and mA selection in CT has been developed in this work that is applicable to both linear and nonlinear CT systems such as those equipped with MBIR. The maximum dose reduction can be potentially achieved by combining MBIR with optimal kV-mA selections.

## CLINICAL RELEVANCE/APPLICATION

This framework can help with the optimization of kV and mAs selection, the most important measure in daily CT exams to reduce unnecessary radiation exposures to the patients.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Meghan G. Lubner, MD - 2014 Honored Educator

Meghan G. Lubner, MD - 2015 Honored Educator

## **SSQ19-04 Inserting Realistic Lesions into CT Images: A Valuable Tool for Optimization of CT Image Quality and Radiation Dose**

Thursday, Dec. 3 11:00AM - 11:10AM Location: S403B

### **Awards**

#### **Trainee Research Prize - Resident**

#### **Participants**

Baiyu Chen, Rochester, MN (*Presenter*) Nothing to Disclose  
Chi Ma, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose  
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### **PURPOSE**

To optimize CT image quality and radiation dose for lesion detection tasks, patient images with lesions of known characteristics are needed. Although these images can be collected via clinical trials, the process is expensive and time consuming. This study aims to validate a recently developed lesion insertion technique, which allows lesions of known characteristics to be inserted into patient CT images for evaluation of detection performance.

### **METHOD AND MATERIALS**

Lesions were segmented from patient CT images, forward projected, and inserted into patient CT projections using a recently developed computer program. The modified patient projections were formatted to match that of commercial CT raw data and reconstructed on scanners to yield images with inserted lesions. To validate the realism of the inserted lesions, 54 liver lesions were segmented from patient images and inserted back into the same patients at new locations. The 54 inserted lesions, together with the 54 real lesions in their original locations, were examined interactively in consensus by two experienced radiologists. First, the 108 lesions were viewed in a randomized and blinded fashion. Each lesion was scored from 1 to 10 (1=absolutely inserted to 10=absolutely realistic). Second, the 108 lesions were viewed in pairs (real vs inserted) in a blinded fashion with radiologists instructed to select the inserted lesion and provide a confidence level (1=no confidence in determination to 5=completely certain).

### **RESULTS**

For the lesions viewed randomly, 35 inserted and 39 real lesions were scored  $\geq 7$ , whereas 6 inserted and 2 real lesions were scored  $\leq 3$ . The medians and interquartile ranges of the scores were the same for real and inserted lesions (median 8; interquartile range 6-8). The p-value of a paired t-test was 0.3. For the lesions viewed in pairs, the inserted lesions were incorrectly identified in 27/54 pairs (50%) when not considering the confidence level, or 5/11 pairs (45%) when radiologists were confident they had correctly identified the inserted lesion (confidence level  $\geq 4$ ).

### **CONCLUSION**

A lesion insertion technique has been developed and validated, which can be used for optimization of image quality and radiation dose.

### **CLINICAL RELEVANCE/APPLICATION**

The successful insertion of lesions into patient images allows quick evaluation of new techniques such as iterative reconstruction, such that patient image quality and radiation dose can be optimized.

## **SSQ19-05 Accuracy of Lung Nodule Volume Measurement in Lung-cancer Screening CT at Radiation Dose Level Equivalent to Chest X-rays**

Thursday, Dec. 3 11:10AM - 11:20AM Location: S403B

#### **Participants**

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Cynthia H. McCollough, PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, Siemens AG

### **PURPOSE**

Use of an x-ray beam with added tin filter (100Sn) may allow lung cancer screening CT to be performed at a dose level approaching that in a chest x-ray. The purpose of this study was to evaluate the accuracy of lung nodule volume measurements at such a low dose level.

### **METHOD AND MATERIALS**

An anthropomorphic chest phantom (Lungman, Kyoto Kagaku) was used to simulate an adult patient. Total of eight spherical nodules at two contrasts (100 and -800 HU) and four sizes (5, 8, 10 and 12 mm diameter) were attached to simulated pulmonary vessels. The nodules were located at similar distance from the isocenter to reduce the impact of non-uniform spatial resolution across the field of view. The phantom was scanned on a 192-slice CT scanner (Force, Siemens) using 100Sn kV at 4 dose levels (0.1, 0.15, 0.4, and 1.5 mGy). The two lowest dose levels at 100Sn corresponded to effective doses similar to a typical 2-view chest x-ray. The phantom was also scanned using 120 kV at 3 dose levels (0.4, 1.3, 6.9 mGy). Images were reconstructed using an IR method (ADMIRE, Siemens) with a kernel of Bv49-2. An experienced radiologist selected a seed point for automated nodule segmentation and volume measurement for all 8 nodules on each of the 7 datasets using automated segmentation tool (LungSAT,

TeraRecon iNtuition version 4.4.11.164.7713). The accuracy of the volume measurement was quantified as the percent difference between the estimated volume and the nominal volume provided by the phantom manufacturer.

## RESULTS

Percent errors remained relatively stable for high-contrast nodules (100HU) for both 120 kV and 100Sn at all dose levels. At the lowest dose level at 100Sn, the percent errors (16%, -16%, -13%, -9% for 5, 8, 10, and 12 mm nodules) were close to that at the highest dose level (18%, -15%, -9%, -8%). Accuracy degraded with the lower contrast nodules at -800 HU. The percent errors were -67%, -67%, -96%, -98% for the four sizes at the lowest dose level compared to 113%, 20%, 80%, 59% at the highest dose level at 100Sn.

## CONCLUSION

Accuracy of automated volume measurement was maintained on high-contrast nodules at a dose level equivalent to a chest x-ray using the added tin filter in lung cancer screening CT. Accuracy may degrade for low-contrast nodules due to increased noise.

## CLINICAL RELEVANCE/APPLICATION

At the dose levels used for lung cancer screening, the accuracy of automated measurements of lung volume is an important parameter to assess.

## SSQ19-06 Method for Producing Surrogate Soft-tissue Materials for X-ray and CT Phantom Imaging Studies

Thursday, Dec. 3 11:20AM - 11:30AM Location: S403B

### Participants

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### PURPOSE

Phantom studies are used to develop and validate CT imaging performance; however, it has been difficult to obtain materials that closely approximate the energy-dependent X-ray attenuation of human soft tissues. We sought to develop a simple method for producing soft-tissue equivalent materials that can be easily modified with low concentrations of contrast media in order to accurately emulate perfused internal organs.

### METHOD AND MATERIALS

We evaluated hypothetical mixtures of water, glycerol, butanol, methanol, NaCl, and KNO<sub>3</sub> which were intended to emulate human adipose, blood, brain, kidney, liver, muscle, pancreas, and skin. We compared the hypothetical densities and simulated X-ray attenuation coefficients of the proposed materials with those of human tissue elemental composition as specified in ICRU Report 46. We then physically formulated the proposed liquid surrogates for adipose, liver, and pancreas, and measured the HU of these materials when placed within a medium-sized anthropomorphic phantom in a 64-slice clinical CT scanner operating at 80, 100, 120, and 140 kVp.

### RESULTS

The predicted densities and simulated X-ray attenuation coefficients of our proposed formulations agreed with those of ICRU tissue compositions within <1%. For example, the densities (g/mL) of our hypothetical materials (and ICRU's) were: adipose 0.947 (0.95), pancreas 1.041 (1.04), and liver 1.059 (1.06); the monochromatic energy HU at 60 keV of our hypothetical materials (and ICRU's) were: adipose -88.3 (-88.7), pancreas 31.1 (31.3), and liver 55.7 (55.2). The densities of our physically formulated materials were: adipose 0.947, pancreas 1.061, and liver 1.074. Our empirical HU measurements at 80 kVp were: adipose -85, pancreas 48, and liver 67; at 120 kVp these were: adipose -66, pancreas 51, and liver 65.

### CONCLUSION

Our method for formulation of tissue surrogates allowed rapid production of materials with HU values at CT that closely matched the target tissues' expected HU values and HU trends with kVp. Further study is warranted, such as comparison with commercial tissue-equivalent plastics, and introduction of contrast agents. Validation may potentially accelerate development and testing of advanced CT imaging technologies.

### CLINICAL RELEVANCE/APPLICATION

Our tissue emulation method may accelerate development of optimized CT imaging technologies such as quantitative spectral imaging and for detection of subtle characteristics in diseased soft tissues.

## SSQ19-07 Initial Application of Attenuation-based kV Select Technique (kV Assist) in Lumbar CT Examination

Thursday, Dec. 3 11:30AM - 11:40AM Location: S403B

### Participants

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Xin Deng, MD, Tianjin, China (*Abstract Co-Author*) Nothing to Disclose  
Jian Li, Tianjin, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

As a newly introduced technique, tube kilovolt (kV) assist based on the attenuation profile of the scout scan provides automated kV and mA selection. Aim of this study was to assess radiation dose reduction and image quality for lumbar CT examination with kV Assist technique, compared to a standard 120 kV protocol.

#### **METHOD AND MATERIALS**

With institutional review board approval, 60 patients (male, 30-40y) underwent lumbar CT scan were randomly separated into two groups: conventional 120 kV group with tube current of 230mA (n=30) and kV assist group (n=30). The slice thickness was 1.25mm. Image noise and CT value of the L3 vertebral body center level and erector spinae were measured. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) for vertebral body were calculated, according to the formulas:  $SNR = CT_{ver}/SD$  and  $CNR = (CT_{ver} - CT_{mus})/SD$ . The volumetric CT dose index (CTDI<sub>vol</sub>) was recorded. Subjective image quality was evaluated by two radiologists with a 5-grade scale. Data was compared with student T-test and rank sum test.

#### **RESULTS**

With kV Assist, the percentage of patients scanned using 80 kV, 100 kV and 120 kV was 80.2%, 16.7 % and 3.1 %, respectively. 140 kV was not selected in this study. Compared with the conventional 120 kV protocol, kV Assist allowed for an overall average decrease of 45 % in CTDI<sub>vol</sub> ( $8.73 \pm 0.28$  mGy vs  $15.77 \pm 0.10$  mGy,  $p < 0.05$ ). The SNR have no statistical difference between kV assist group and conventional 120 kV group ( $2.54 \pm 0.67$  vs  $2.95 \pm 0.60$ ,  $p > 0.05$ ). The CNR and image quality score of kV assist group were higher than those of conventional 120 kV group (CNR,  $2.23 \pm 0.92$  vs  $1.75 \pm 0.60$ ; score,  $4.40 \pm 0.52$  vs  $3.60 \pm 0.70$ , both  $p < 0.05$ ).

#### **CONCLUSION**

In lumbar CT examination, application of attenuation-based kV Assist technique enables an average of 45% dose reduction in enhanced, and provide better image quality.

#### **CLINICAL RELEVANCE/APPLICATION**

As a newly introduced technique, application of kV assist technique enables an average of 45% dose reduction in enhanced in lumbar CT examination, and provide better image quality.

#### **SSQ19-08 Detectability of Low-Contrast, Low-Attenuation (LCLA) Liver Lesions on CT with FBP and ADMIRE: Assessment using a Channelized Hotelling Model Observer**

Thursday, Dec. 3 11:40AM - 11:50AM Location: S403B

#### **Participants**

Arjun Maniyedath, MS, Shaker Heights, OH (*Presenter*) Employee, Plexar Associates, Inc  
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Mark E. Baker, MD, Cleveland, OH (*Abstract Co-Author*) Research Consultant, Bracco Group; Researcher, Siemens AG; Research support, Siemens AG  
Brian R. Herts, MD, Cleveland, OH (*Abstract Co-Author*) Research Grant, Siemens AG

#### **PURPOSE**

To assess differences in detectability of LCLA liver lesions with filtered back-projection (FBP) and Advanced Modeled Iterative Reconstruction (ADMIRE) in a semi-anthropomorphic phantom using a model observer.

#### **METHOD AND MATERIALS**

A custom-designed abdominal phantom with low attenuation (90 HU) liver insert (10-cm length x 10-cm diameter) containing 3 copies each of 4 unique spherical lesions (15-mm x 84 HU, 10 mm x 78 HU, 10 mm x 72 HU, and 5 mm x 66 HU) was scanned on a Siemens Somatom Force CT scanner at 6 exposure settings: 200, 160, 120, 80, 40 and 20 effective mAs. At each exposure level, liver insert was rotated by 90 degrees and 25 scans were performed per rotation to allow assessment of lesion-present/absent pairs from the same [X,Y,Z] location in the phantom (for a total of 100 scans at each exposure). Images were reconstructed with both FBP and ADMIRE (strengths 3 and 5). A Channelized Hotelling Model Observer with 40 Gabor channels was used to evaluate pairs of 100 images, and the detectability signal-to-noise ratio (d') values were computed.

#### **RESULTS**

The CHMO showed progressively higher d' values for greater ADMIRE strengths compared to FBP at all exposure levels. ADMIRE showed largest improvement of 26% in d' for the largest lesion (15 mm x 6HU). The low contrast detectability (LCD) improvement was in the 3-18% range for the 10mm x 18HU and 10mm x 12 HU lesions, across the six dose levels. The three different 5mm x 24 HU lesions had inconsistent and inconclusive results.

#### **CONCLUSION**

Our CHMO analysis showed improved LCD performance of ADMIRE with respect to FBP at all exposure levels for all 10mm and 15mm lesions.

#### **CLINICAL RELEVANCE/APPLICATION**

Objective assessment of low contrast detectability performance in a controlled environment is important in order to determine the dose reduction potential of novel iterative reconstruction methods without loss of diagnostic accuracy in detection of low-contrast liver lesions.

#### **SSQ19-09 Reexamination of the Meaning of Effective Energy in CT**

Thursday, Dec. 3 11:50AM - 12:00PM Location: S403B

#### **Participants**

Austin Healy, MS, Greenwich, NY (*Presenter*) Employee, The Phantom Laboratory  
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Consultant, The Phantom Laboratory; Consultant, Live Radiology, LLC; Consultant, Image Owl, Inc  
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Asbjorn Kristbjornsson, Reykjavik, Iceland (*Abstract Co-Author*) Research funded, Image Owl, Inc

## **PURPOSE**

This paper will reexamine the concept and interpretation of the use of "effective energy" in CT. We identify caveats in interpretation compared to the historical use of the term in Radiation Physics, particularly as it pertains to Radiological Imaging. In particular, we examine how issues related to reconstruction of data acquired at the detector, over many projection angles and variable object thickness and shape can lead to significant differences compared to attenuation data acquired using attenuating sheets between the source and the detector. We address the issue of how the resulting CT numbers are related to the differential attenuation of a material compared to water, considering various corrections for beam hardening, scatter, beam shaping filters and all aspects of possible manipulation following the original reconstruction.

## **METHOD AND MATERIALS**

The Catphan® (The Phantom Laboratory, Salem, NY), designed to offer test objects of known (or calculable) density and x-ray attenuation properties, was scanned using different scanners and protocols. The resulting CT numbers are plotted against a series of attenuation coefficients that result from assuming different effective energies of the CT beam. The best fit to the measured data compared to the energy dependent coefficients is obtained. Contrast scale and noise, functions of the choice of effective energy and required by the FDA, are calculated.

## **RESULTS**

CT scans of known materials at various kVp's, filtration, and scanner design are used to show the sometimes confusing results of effective energy. In particular, wide x-ray beams such as used in large multislice scanners and volume scanners are shown to lead to ambiguous and in some cases clearly flawed results. Although the term is shown to be somewhat useful in a constancy sense, its use is shown as challenging in a Radiation Physics sense.

## **CONCLUSION**

The challenges to measurement and interpretation of "effective energy" in CT are shown. It is suggested that a new term might be used to reinforce the caveats in the measurement in this term. This term could be as simple as  $E_{eff}$  (CT) but any other term to move away from the classical meaning of effective energy and related radiation measurements might be useful.

## **CLINICAL RELEVANCE/APPLICATION**

Since the FDA requires a measure of the Contrast Scale in evaluating CT performance, it is important to understand the concept of "effective energy" may be misleading to the radiologist and the physicist.

SSQ07

## Gastrointestinal (Colon and Appendix)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E353C



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

**FDA** Discussions may include off-label uses.

### Participants

Andrea Laghi, MD, Rome, Italy (*Moderator*) Speaker, Bracco Group Speaker, Bayer AG Speaker, General Electric Company Speaker, Koninklijke Philips NV  
Rizwan Aslam, MBBCh, San Francisco, CA (*Moderator*) Research support, Bayer AG

### Sub-Events

#### SSQ07-01 Diffusion-weighted MRI for Evaluating Ileocolonic Inflammation in Crohn' Disease

Thursday, Dec. 3 10:30AM - 10:40AM Location: E353C

### Participants

Xuehua Li II, Guangzhou, China (*Presenter*) Nothing to Disclose  
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Ziping Li, MD, PhD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To assess the efficacy of Diffusion-weighted MRI (DWI) for evaluating ileocolonic inflammation in patients with Crohn' disease (CD).

### METHOD AND MATERIALS

25 CD patients underwent MR enterography (MRE) with DWI using three b values of 50, 400 and 800 s/mm<sup>2</sup> and ileocolonoscopy within one month. The conventional MRE findings (including mural thickness, T2 weighted signal intensity and contrast enhancement) and DWI signal intensity in bowel segments were qualitatively scored from 0 to 3. Apparent diffusion coefficient (ADC) map was generated by using monoexponential model. Disease activity was scored by simple endoscopic score for Crohn's disease (SES-CD) immediately after each endoscopy and was graded as inactive (0-2) and active CD ( $\geq 3$ ). The relationship between SES-CD and MRI results was analyzed. All MRI results were interpreted by two radiologists who blinded to clinical data independently.

### RESULTS

Of the 102 evaluated segments (terminal ileum=20, colon/rectum=82), 55 segments were active CD. The ADCs of active CD were significantly lower than those of inactive CD (  $P < 0.001$ ), while DWI scores were higher in active CD (  $P < 0.001$ ). The SES-CD correlated closely with ADCs (  $r = -0.92$ ,  $P < 0.001$ ), followed by DWI scores (  $r = 0.88$ ,  $P < 0.001$ ), MRE+DWI scores (  $r = 0.88$ ,  $P < 0.001$ ) and MRE scores (  $r = 0.85$ ,  $P < 0.001$ ). ADCs discriminated between active and inactive CD with an area under the ROC curves of 0.99, followed by DWI scores (AUC=0.98), MRE+DWI scores (AUC=0.98) and MRE scores (AUC= 0.94). The threshold ADC of  $1.59 \times 10^{-3}$  mm<sup>2</sup>/s yielded 95.70% sensitivity and 96.40% specificity. Inter-observer agreements were good with regard to DWI scores (  $\kappa = 0.65$ ,  $P < 0.001$ ) and ADC measurement (intra-class correlation coefficient=0.97,  $P < 0.001$ ).

### CONCLUSION

DWI and ADC correlate with disease activity in ileocolonic Crohn' disease with excellent diagnostic accuracy for differentiating active from inactive CD.

### CLINICAL RELEVANCE/APPLICATION

DWI and ADC are conducive to assess disease activity of Crohn' disease.

#### SSQ07-02 Dual Energy Spectral CT for Assessing the Stages of Colon Cancer

Thursday, Dec. 3 10:40AM - 10:50AM Location: E353C

### Participants

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Qi Yang, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose  
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Taiping He, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate the value of dual energy spectral CT in assessing the stages of colon cancer.

### METHOD AND MATERIALS

This study was approved by our ethics committee. We retrospectively analyzed 47 colon cancer patients who underwent



preoperative dual-phase contrast enhanced spectral CT scans. Patients were divided into the well-differentiated group (A) and the poorly and undifferentiated group (B) based on the pathological findings for analysis. Iodine concentration (IC) for tumors was measured in arterial phase (AP) and venous phase (VP) on the iodine-based material decomposition images and normalized to that of aorta to obtain normalized IC (NIC). Tumor CT attenuation number was measured on the monochromatic image sets to generate spectral HU curve and to calculate a slope (k) for the curve:  $(CT(40keV)-CT(90keV))/50$ . Values of the 2 groups were compared and ROC study was performed to assess the differential diagnosis performance.

## RESULTS

There were 18 well-differentiated cases (group A) and 20 poorly differentiated and 9 undifferentiated cases (group B). CT numbers on the 70keV images were statistically the same in both groups ( $48.61\pm 9.03HU$  vs.  $63.97\pm 15.86HU$ ,  $p>0.05$ ). On the other hand, The IC, NIC and slope (k) values in AP for group A were significantly lower than those for group B ( $1.01\pm 0.20mg/ml$  vs.  $1.59\pm 0.57mg/ml$  for IC;  $0.12\pm 0.03$  vs.  $0.19\pm 0.09$  for NIC;  $1.41\pm 0.29$  vs.  $2.03\pm 0.85$  for slope, all  $p<0.05$ ). Using iodine concentration value of  $1.13mg/ml$  in AP as a threshold, one could obtain an area-under-curve of 0.85 for ROC study with sensitivity of 81.8% and specificity of 71.4% for differentiating well-differentiated from poorly differentiated colon cancers. These values were significantly higher than the respective values of 72.7% and 64.3% with conventional CT numbers at 70keV.

## CONCLUSION

Quantitative parameters obtained in spectral CT in the arterial phase improve accuracy for differentiating well-differentiated colon cancers from poorly differentiated and un-differentiated ones.

## CLINICAL RELEVANCE/APPLICATION

Quantitative iodine concentration measurement in spectral CT may be used to improve accuracy for the differentiation of well-differentiated and poorly and un-differentiated colon cancers.

### SSQ07-04 Extramural Venous Invasion Detected by Contrast-enhanced Multiple-row Detectors Computed Tomography (ceMDCT) as a Predictor of Synchronous Metastases in Patients with Colon Cancer

Thursday, Dec. 3 11:00AM - 11:10AM Location: E353C

#### Participants

Suxing Yang, Beijing, China (*Presenter*) Nothing to Disclose  
Xun Yao, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Xinghe Song, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
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Nan Hong, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Yi Wang, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To determine whether extramural venous invasion (EMVI), detected by contrast-enhanced multiple-row detectors computed tomography (ceMDCT), can be used as an adverse feature to predict synchronous metastases in patients with colon cancer.

## METHOD AND MATERIALS

Patients with pathology-proven colon cancer from January 2009-December 2013 were included in this retrospective study. Patients with other malignancies and/or intussusception were excluded. Two radiologists reviewed patients' ceMDCT images and reached a consensus on tumor classification and lymph node categorization in accordance with the American Joint Committee on Cancer (AJCC)-7th Edition. Furthermore, two radiologists reached a consensus regarding EMVI status, extramural tumor depth, and tumor location. Tumor and lymph node categories, and AJCC stage and tumor differentiation were determined from patients' pathology records. Synchronous metastases were confirmed by whole body ceMDCT within 3 months after initial diagnosis or by surgery, if available. Chi-squared and Fisher's exact tests were used to analyze the association between EMVI and tumor characteristics. Logistic regression analyses were performed to analyze whether EMVI status was a predictive factor of metastases in colon cancer.

## RESULTS

250 patients were reviewed. EMVI was observed in 106 patients (106/250, 42.4%). In the EMVI-positive group, synchronous metastases were seen in 39 patients (39/106, 36.8%) while 10 (10/144, 6.9%) patients in the EMVI-negative group had confirmed metastases. EMVI was moderately associated with extramural tumor depth and AJCC stage (contingency coefficient 0.443 and 0.401 respectively,  $P<0.001$ ), which were then excluded from all multivariable analyses. EMVI status and pathologic lymph node categories were demonstrated to be significant factors (Odds ratio 7.8 and 9.6,  $P<0.001$ ) in predicting synchronous metastases.

## CONCLUSION

EMVI may be used as a significant adverse feature to predict an increased risk of synchronous metastases in colon cancer patients.

## CLINICAL RELEVANCE/APPLICATION

ceMDCT can demonstrate extramural venous invasion and is recommended for the initial evaluation of colon cancer before curative surgery and adjuvant chemotherapy.

### SSQ07-05 Stercoral Perforation and Colorectal Cancer Perforation; Differentiating CT Features

Thursday, Dec. 3 11:10AM - 11:20AM Location: E353C

#### Participants

Sujin Ko, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
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Jiyoung Hwang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hyun-Joo Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Sung Hwan Bae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To determine the computed tomography (CT) signs associated with stercoral perforation and colorectal cancer perforation.

#### **METHOD AND MATERIALS**

From 8 years, all surgically and pathologically confirmed patients with stercoral perforation (n=8, mean age 68.3 years) or colon cancer perforation (n=11, mean age 66.3 years) were retrospectively reviewed by two board-certified radiologists blinded to the proven diagnosis. The following CT findings were evaluated and recorded for each patient: wall thickness of distal colon adjacent to perforation site, pattern of colon wall thickening and enhancement, length of thickened bowel wall, presence of fecaloma, degree of proximal colon dilatation, and pericolonic inflammation or presence of pericolonic abscess, and number of enlarged pericolonic lymph nodes. These findings were correlated with the pathologic diagnosis.

#### **RESULTS**

The mean thickness of the distal colonic wall adjacent to the perforation site was 13.6 mm in patients with colorectal cancer perforation and 5.1 mm with stercoral perforation, which was statistically different. There was a significant correlation between colorectal cancer perforation and eccentric wall thickening ( $p<0.01$ ). CT findings of layered enhancing wall thickening ( $p<0.01$ ) and presence of fecaloma in proximal colon ( $p<0.01$ ) were significant findings for stercoral perforation. Patients with colorectal cancer displayed more pericolonic lymph nodes (mean 2.27,  $p<0.05$ ).

#### **CONCLUSION**

Fecaloma in the proximal colon and layered enhancing wall thickening adjacent to perforation site are likely due to stercoral perforation. Eccentric bowel wall thickening at the distal portion of the perforation site with many enlarged pericolonic lymph nodes is most likely colorectal cancer perforation.

#### **CLINICAL RELEVANCE/APPLICATION**

Resection of the diseased segment of colon and exteriorization is sufficient for stercoral perforation, while extensive bowel resection with lymph node dissection is required for treatment of colorectal cancer perforation. Thus, distinguishing these two conditions and accurate preoperative diagnosis can facilitate early therapeutic management and improve survival.

#### **SSQ07-06 Comparison of Diagnostic Performance of US Re-evaluation and CT Reassessment for Patients with Equivocal CT Findings of Acute Appendicitis**

Thursday, Dec. 3 11:20AM - 11:30AM Location: E353C

#### **Participants**

Ji Ye Sim, MD, MS, Seongnam-Si, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Hyuk Jung Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Suk Ki Jang, Sungnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jae Woo Yeon, Sungnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Il Dong Kim, Sungnam, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
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So Ya Paik, Sungnam, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Young Rock Ha, Sungnam, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

To compare diagnostic performance between US re-evaluation and CT reassessment for patients with equivocal CT findings of acute appendicitis, overall and coexistent inflammation group

#### **METHOD AND MATERIALS**

Our Institutional Review Board approved this retrospective study and waived informed consent. 115 patients who had equivocal CT findings of acute appendicitis and underwent US re-evaluation were included. All CTs were reviewed independently by two abdominal radiologists. They analyzed four CT findings (appendiceal wall enhancement, appendiceal wall thickening, intraluminal air in appendix, and a coexistent inflammatory lesion) and make a diagnosis of acute appendicitis. In US analysis, patients were categorized into positive and negative appendicitis, based on previous structured US reports. The diagnostic performance of CT reassessment and US re-evaluation, interobserver agreement of CT findings and the likelihood of appendicitis were calculated.

#### **RESULTS**

The overall AUC, sensitivity and specificity of US re-evaluation (0.960, 100% and 92.1%) was higher than CT reassessment (reviewer 1: 0.697, 51.9% and 87.5%, reviewer 2: 0.759, 66.7% and 85.2%). In the coexistent inflammation group, the AUC, sensitivity and specificity of US re-evaluation (reviewer 1 and 2: 0.990, 100% and 98.0%) were also higher than CT reassessment (reviewer 1: 0.607, 27.3% and 94.1%, reviewer 2: 0.561, 14.3% and 98.0%). Interobserver agreement of diagnosing appendicitis and alternative diagnosis were moderate ( $\kappa=0.44$  and 0.51).

#### **CONCLUSION**

For patients with equivocal CT findings of acute appendicitis, US re-evaluation shows better diagnostic performance than CT reassessment in both of overall and coexistent inflammation group.

#### **CLINICAL RELEVANCE/APPLICATION**

When patient have equivocal findings of appendicitis on CT, US re-evaluation can improve diagnostic accuracy.

#### **SSQ07-07 CT Differentiation of the Non-Mucocele Type Appendiceal Neoplasm: Benign versus Malignant**

Thursday, Dec. 3 11:30AM - 11:40AM Location: E353C

#### **Participants**

Youngjong Cho, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Hyuk Jung Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Suk Ki Jang, Sungnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jae Woo Yeon, Sungnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The purpose of this study was to evaluate the feasible CT findings for differentiating malignant from benign lesions in cases of non-mucocele type appendiceal neoplasms.

## METHOD AND MATERIALS

All consecutively registered patients with pathologic confirmed appendiceal neoplasms and pre-operative CT scans ( n=60 ) were obtained over a 14-year period from January 2000 through December 2014. Of these patients, borderline malignancy ( n=28 ) and mucocele type appendiceal neoplasm ( n=4 ) were eliminated by pathologic reports and the remaining 28 patients with non-mucocele type appendiceal neoplasm finally formed the study sample. The patients were classified into benign and malignant group depending on their pathologic reports. The colonic type adenoma ( n=3 ), mucinous cystadenoma ( n=10 ), benign appendiceal neuroendocrine tumor ( n=4 ), and ganglioneuroma ( n=1 ) were included in the benign group and the colonic type adenocarcinoma ( n=4 ), malignant appendiceal neuroendocrine tumor ( n=3 ), lymphoma ( n=1 ) and metastasis ( n=2 ) formed into the malignant group. Two experienced radiologists analyzed the presence of mass, irregular wall thickening, perforation, cecal wall thickening, appendicolith, peritoneal thickening, ascites, lymphadenopathy suggestive of malignancy, and periappendiceal fat infiltrations in consensus reading. The CT results were compared for malignant and benign groups.

## RESULTS

CT showed statistically significant difference in irregular wall thickening, presence of mass and perforation between the benign and malignant groups (  $p < 0.05$  ). Cecal wall thickening, appendicolith, peritoneal thickening, ascites, lymphadenopathy suggestive of malignancy, and periappendiceal fat infiltrations did not exhibit significant difference between the benign and malignant groups (  $p > 0.05$  ).

## CONCLUSION

It is difficult to distinguish underlying malignancy from benign condition, regarding non-mucocele type appendiceal neoplasm. However, irregular wall thickening, presence of mass and perforation can be useful CT features associated with malignancy.

## CLINICAL RELEVANCE/APPLICATION

Irregular wall thickening, presence of mass, and perforation can be applicable CT features in the pre-operative diagnosis of underlying malignancy concerning non-mucocele type appendiceal neoplasm.

## SSQ07-08 Preoperative CT Predictors Associated with 30-day Adverse Events in Patients with Appendiceal Inflammatory Masses that Underwent Immediate Appendectomies

Thursday, Dec. 3 11:40AM - 11:50AM Location: E353C

### Participants

Myung Sub Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Mi Sung Kim, MD, Koyang, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Dong Hyun Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hae Won Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hee-Jin Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
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Heon-Ju Kwon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate preoperative CT predictors that are associated with 30-day adverse events in patients that underwent an immediate appendectomy for appendiceal inflammatory masses.

## METHOD AND MATERIALS

One hundred forty-four patients who underwent immediate appendectomy, and were diagnosed with an appendiceal inflammatory mass by the preoperative CT examination, were included. The main outcome was the 30-day adverse events. Patient demographics, preoperative CT and laboratory parameters were evaluated. Factors associated with 30-day adverse events were assessed using logistic regression analysis.

## RESULTS

A total of 22 (15%) of the 144 patients had 30-day adverse events: 10 intra-abdominal abscesses, three wound infections, two cases of peritonitis, two small bowel obstructions, two intra-abdominal abscesses with peritonitis, one intra-abdominal abscess with wound infection, one intra-abdominal abscess with obstructed ileus, and one case of peritonitis with obstructed ileus. In univariate analysis, the presence of appendicolith (odds ratio [OR], 2.49;  $p = 0.048$ ), and obstructed ileus (OR 3.79;  $p = 0.01$ ) were associated with adverse events. Obstructed ileus (adjusted OR, 3.05;  $p = 0.04$ ) was the only independent preoperative predictor associated with 30-day adverse events in patients with appendiceal inflammatory masses.

## CONCLUSION

Obstructed ileus was an independent preoperative CT predictor associated with 30-day adverse events in patients that underwent immediate appendectomy for appendiceal inflammatory masses.

## CLINICAL RELEVANCE/APPLICATION

Non-operative approach, such as percutaneous drainage or use of antibiotics might be considered if obstructive ileus was accompanied preoperatively in patients having appendiceal inflammatory mass.

## SSQ07-09 Initial Performance of Radiologists and Radiology Residents in Interpreting Low-dose (2-mSv) Appendiceal CT

Thursday, Dec. 3 11:50AM - 12:00PM Location: E353C

### Participants

Hyun Kyung Yang, MD, Seongnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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Perry J. Pickhardt, MD, Madison, WI (*Abstract Co-Author*) Co-founder, VirtuoCTC, LLC; Stockholder, Collectar Biosciences, Inc; Research Consultant, Bracco Group; Research Consultant, KIT ; Research Grant, Koninklijke Philips NV  
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Kyoung Ho Lee, MD, Seongnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## **PURPOSE**

To prospectively evaluate the initial diagnostic performance and learning curve of a community of radiologists and residents in interpreting 2-mSv appendiceal CT.

## **METHOD AND MATERIALS**

The institutional review boards approved the study. We included 46 attending radiologists and 153 radiology residents from 22 hospitals, who completed an online training course of 30 2-mSv CT cases. Appendicitis was confirmed in 14 cases. Most of the readers had limited ( $\leq 10$  cases,  $n = 32$ ) or no ( $n = 118$ ) prior exposure to low-dose (LD) appendiceal CT. The order of cases was randomized for each reader. Multi-reader multi-case receiver operating characteristic (ROC) analysis was performed. Generalized estimating equations were used to model the learning curves in diagnostic performance.

## **RESULTS**

Diagnostic performance gradually improved with years of training. Average area under the ROC curve was 0.94 (95% confidence interval, 0.90, 0.98) 0.92 (0.88, 0.96), 0.90 (0.85, 0.96), and 0.86 (0.80, 0.92), for the attending radiologists, senior residents, second-year residents, and first-year residents, respectively. We did not observe any notable intra-reader learning curves over the training course of the 30 cases, except for a decrease in reading time. Diagnostic accuracy and sensitivity were significantly affected by the reader training level and prior overall experience with appendiceal CT, but not by the prior specific exposure to LD appendiceal CT.

## **CONCLUSION**

The learning curve is likely prolonged and forms gradually over years by overall radiology training and clinical experience in general rather than by the exposure to LD appendiceal CT specifically.

## **CLINICAL RELEVANCE/APPLICATION**

The clinical implementation of 2-mSv CT may be feasible in many hospitals, assuming qualified site radiologists can carefully supervise the practice. The learning curve is likely prolonged and forms gradually over years by overall radiology training and clinical experience in general rather than by the exposure to LD appendiceal CT specifically. Performance improves with years of CT experience, with senior residents' performance nearly matching that of attending radiologists.

## **Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Perry J. Pickhardt, MD - 2014 Honored Educator

SSQ13

## Musculoskeletal (Arthritis)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E451A



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

### Participants

Leon Lenchik, MD, Winston-Salem, NC (*Moderator*) Nothing to Disclose

Brady K. Huang, MD, San Diego, CA (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ13-01 Calcium Pyrophosphate Deposition Disease Detected with MRI Is Associated with Accelerated Cartilage Degeneration-Data from the Osteoarthritis Initiative

Thursday, Dec. 3 10:30AM - 10:40AM Location: E451A

### Participants

Alexandra S. Gersing, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

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John A. Lynch, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

Charles E. McCulloch, San Francisco, CA (*Abstract Co-Author*) Instructor, F. Hoffmann-La Roche Ltd Expert Witness, Mallinckrodt plc Consultant, Mallinckrodt plc

Lynne S. Steinbach, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

Thomas M. Link, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Research funded, General Electric Company; Research funded, InSightec Ltd; Royalties, Springer Science+Business Media Deutschland GmbH; Research Consultant, Pfizer Inc;

### PURPOSE

To evaluate sensitivity of different MRI sequences regarding detection of calcium pyrophosphate deposition disease (CPPD) lesions within cartilage and menisci and to longitudinally analyze if CPPD lesions are associated with accelerated cartilage degeneration.

### METHOD AND MATERIALS

Subjects with radiographic evidence of CPPD (n=90, age 67.7±7.3y, 50 females) were randomly selected from the Osteoarthritis Initiative and frequency matched for age, sex, baseline KL and BMI to controls without CPPD (n=90). On AP knee radiographs, CPPD status was determined. Sensitivity of T1-weighted 3D FLASH, 3D DESS, 2D intermediate (IW) and proton density (PD)-weighted sequences obtained at 3T MRI was assessed in randomized order by two radiologists blinded to radiographic CPPD status, by grading visualization and morphology of cartilage and meniscal CPPD lesions, as well as focal cartilage degeneration at baseline and after 48 months. For analysis multivariate regression models were used to examine associations between CPPD lesions detected with MRI and with radiographs as well as longitudinal changes of cartilage morphology.

### RESULTS

Lesion count in menisci and cartilage of the tibiofemoral joint detected by different MRI sequences correlated significantly with degree of CPPD determined on radiographs ( $r(\text{FLASH})=0.73$ ,  $r(\text{DESS})=0.68$ ,  $r(\text{IW})=0.51$ ,  $r(\text{PD})=0.40$ ,  $P<0.001$ ). Overall, visualization of cartilage lesions was significantly higher rated in FLASH ( $P<0.05$ ) and significantly more CPPD lesions were detected with FLASH compared to DESS, IW and PD sequences (for each,  $P<0.05$ ). Progression of focal cartilage degeneration was significantly higher in subjects with CPPD compared to controls ( $P=0.03$ ). At the patella, lesion count was highest, progression of cartilage degeneration was most significant compared to other compartments ( $P=0.03$ ) and a significant association between progression and lesion count was found ( $r=0.64$ ,  $P=0.03$ ).

### CONCLUSION

Our findings demonstrate that T1W FLASH gradient echo sequences were superior to other sequences in detection of CPPD lesions in cartilage. Moreover CPPD was associated with faster progression of cartilage focal degeneration over 48 months compared to controls and occurred most often at the patella.

### CLINICAL RELEVANCE/APPLICATION

MR T1-weighted gradient-echo FLASH sequence allows detection and quantification of CPPD lesions within cartilage and menisci, and may be used to predict progression of focal cartilage degeneration.

#### SSQ13-02 Study of 640-slice Dynamic Volume CT Perfusion and Pathological Changes on Acute Gouty Arthritis of Knee-joint in Rabbit Model

Thursday, Dec. 3 10:40AM - 10:50AM Location: E451A

### Participants

Yabin Hu, MD, Qingdao, China (*Presenter*) Nothing to Disclose

Qing Yang, Qingdao, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To assess 640-slice dynamic volume CT perfusion imaging of acute gout arthritis in rabbit.

### METHOD AND MATERIALS

preparation of acute gout arthritis model. 35 rabbits were randomly divided into two groups: experimental group (30 rabbits) and

control group(5 rabbits).The right knee-joints of experimental group was injected with sodium urate solution and polymyxin, and no treatment was for the control group. The experimental group was divided into six subgroups randomly with five rabbits in each one, and for every 4h, 16h, 32h, 48h, 60h, and 60h after injection, one experimental subgroup underwent CT perfusion scan. The control group was scanned for once at any time. Then time-density curves (T-DC) were depicted, and the values of blood flow (BF), blood volume (BV), clearance rate (CL), and microvessel density (MVD) were computed in the right knee-joints containing experimental and control groups. Rabbits were killed after perfusion, and their right knee-joints were taken for pathologic examination.

## RESULTS

BF, BV, CL and MVD in the experimental group were significantly higher than those in the control group(Independent-samples T test,  $P < 0.05$ ). BF, BV, CL and MVD in experimental group were different at those six intervals(one-way ANOVA and LSD t test,  $P < 0.05$ ). 4h, 16h, and 32h after the injection, BF, BV, and MVD in the experimental group increased slowly, and the peak values were found at 32h. Between 32h ~ 48h, the peak values were relatively stable, and after 48h ~ 72h, they decreased slowly. Between 4h ~ 48h, CL showed a slow ascent,peaking at 48h,and between 48h ~ 60h, the peak was relatively stable with a slow decrease about 60 ~ 72h.

## CONCLUSION

Dynamic volume CT can reflect the hemodynamic changes of acute gouty arthritis in rabbit models. The peak of inflammation and newborn microvessels emerge between 32h ~ 48h, and after that time, the inflammation is in remission with decrease of the number of microvessels. The high perfusion area is consistent with the distribution of newborn microvessels.

## CLINICAL RELEVANCE/APPLICATION

Dynamic-Volume CT can reflect the hemodynamic changes of acute gouty arthritis in rabbit models and the high perfusion area is consistent with the distribution of newborn microvessels.

### SSQ13-03 The Role of US and Magnetic Resonance Imaging In Early Detection of Psoriatic Arthritis; Comparison With Radiographic and Clinical Findings

Thursday, Dec. 3 10:50AM - 11:00AM Location: E451A

#### Participants

Mohammed F. Amin, MBCh, El-Minia, Egypt (*Presenter*) Nothing to Disclose

## PURPOSE

To detect early spondyloarthropathy in patients with psoriasis using both ultrasonography and magnetic resonance imaging comparing those with conventional radiography (x-ray), and clinical assessment.

## METHOD AND MATERIALS

This prospective study was carried out on 50 patients with skin or nail psoriasis, their age ranged between 17 and 75 years, with a mean of  $44.8 \pm 17.5$  years, the duration of psoriasis ranged between 0.5 and 40 years with a mean of  $8.7 \pm 8.7$  years. There were 29 males (58%) and 21 females (42%). Plain x ray to both hands, wrists, feet, lumbar spine, and sacroiliac joint in different radiologic positions, - Ultrasonographic examination to the small joints of both hands and feet as well as sites of enthesopathy in the lower limbs and MRI: Lumbar spine and sacroiliac joint done to detect early changes.

## RESULTS

Abnormal US findings involving at least one finger and/or toe were seen in 9/50 patients, while only 3 patients had one or more X-ray abnormalities. Thirty seven patients (74%) had GUESS  $\geq 1$  at a higher percentage than tenderness revealed by clinical examination (46%), while plain radiography showed abnormalities in only 13 (26%) patients. There was a statistically significant association between arthritis and clinical enthesitis. Fourteen patients had inflammatory back pain (28%), Magnetic resonance imaging demonstrated evidence of inflammation in the spine in 21 (42%) patients and sacroiliitis in 2 (4%) patients. ct early changes.

## CONCLUSION

US is a non invasive tool, proved to be useful early detection of synovial abnormalities in the fingers and toes of patients with suspected PsA. MRI provide valuable help in early detection of psoriatic arthritic changes of the spine and sacroiliac joints. The use of US and MRI offers the opportunity for early diagnosis and early appropriate treatment .aging demonstrated evidence of inflammation in the spine in 21 (42%) patients and sacroiliitis in 2 (4%) patients. ct early changes.

## CLINICAL RELEVANCE/APPLICATION

US is a non invasive tool, proved to be useful early detection of synovial abnormalities in the fingers and toes of patients with suspected PsA. MRI provide valuable help in early detection of psoriatic arthritic changes of the spine and sacroiliac joints.

### SSQ13-04 Styloid Process Elongation on Cervical Spine CT is Associated with Ankylosing Spondylitis but not with DISH

Thursday, Dec. 3 11:00AM - 11:10AM Location: E451A

#### Participants

Gal Yaniv, MD, PhD, Ramat Gan, Israel (*Presenter*) Nothing to Disclose  
Salim Bader, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose  
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Oshri Mozes, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose  
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Iris Eshed, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate if styloid process (SP) elongation, thought to occur due to enthesopathy, is associated with two common enthesitis-

related diseases: ankylosing spondylitis (AS) and diffuse idiopathic skeletal hyperostosis (DISH).

#### **METHOD AND MATERIALS**

Cervical spine CT examinations of patients with DISH (n=41, Resnick criteria), AS (n=23, NY criteria) and a control group of patients with no radiological signs of DISH or AS (n=54) were retrospectively evaluated. The DISH group was further divided into patients with/without cervical DISH. The length of right and left SP was measured independently by two readers on coronal- and sagittal-oblique reformats. The average right and left styloid length and average length per person were compared between the groups.

#### **RESULTS**

Patients' demographic characteristics were similar between the DISH and control groups (average age: 68.2±15.7/69.2±12.7 years, M/F ratio: 24:17/ 35:19, respectively, p>0.05). AS group's age was significantly lower (average age: 53±15 years, p<0.0001) and, composed mainly of men. Inter-reader reliability of SP measurements was excellent in all groups (ICC=0.998, p<0.0001). The AS group but not the DISH group had significantly (p<0.02) longer SP compared to the controls (AS: 38.8±9.6 mm, DISH: 34.9±9 mm, Control: 31.2±10.1 mm). SP length was not different between the two DISH groups (cervical DISH/non-cervical DISH: 35.1±9/34.8±9, p>0.05).

#### **CONCLUSION**

Compared to the controls, significant SP elongation is associated with AS but not with DISH patients. Our findings may be caused by different enthesopathy-related pathophysiology.

#### **CLINICAL RELEVANCE/APPLICATION**

Clinical and radiographic differentiation between AS and DISH may be challenging. The present observation provides an additional differentiating tool to the radiologist's diagnostic armamentarium.

#### **SSQ13-05 Sacroiliac Joint Alterations on CT Examinations of the Lumbar Spine in Patients Younger than 40 years Old: Prevalence and Radiologists' Awareness**

Thursday, Dec. 3 11:10AM - 11:20AM Location: E451A

#### **Participants**

Eyal Klang, Ramat Gan, Israel (*Presenter*) Nothing to Disclose  
Merav Lidar, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose  
Iris Eshed, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

To investigate the prevalence and awareness of reading radiologists for the presence of structural post-inflammatory and other sacroiliac-joint (SIJ) pathologies on lumbar-spine CTs of young patients with low back pain (LBP).

#### **METHOD AND MATERIALS**

499 lumbar-spine CT examinations (8/2012 - 1/2014) of patients 18-40 years old with LBP were retrospectively reviewed. Exams in which the entire SIJs were not visualized were excluded. The SIJs were scored in consensus by a musculoskeletal radiologist and a senior radiologist (study reading) for the presence of structural SIJ findings suggesting the presence of inflammatory sacroiliitis (modified NY criteria). Other SIJs pathologies and anatomic variants were also recorded. The original readings for these exams (all by senior radiologists) were compared to the study reading. 100 CT examinations were re-evaluated for reliability assessment (Intra-class Correlation Coefficient, ICC).

#### **RESULTS**

484 CTs were included (M:F 272:212, average age: 31.6 years). A total of 150 (31%) SIJ alterations were registered [Grade 1-4 sacroiliitis=66(13.6%); Grade 1=29(5.9%), Grade 2=21(4.3%), Grade 3=14(2.9%), Grade 4=2(0.4%), (ICC: r=0.6, P<0.0001); osteitiscondensans-iliac=38(7.8%), diffuse idiopathic skeletal hyperostosis=24(5%), degenerative changes=22(4.5%) and accessory SIJ=22(4.5%)]. The SIJs were referenced 39 times (8.0%) in the original readings; sacroiliitis:1, sclerotic changes:2, degenerative changes:12 and normal SIJ:24. Total diagnostic accuracy for these reports only and for the entire readings were 49%/69% respectively and 13%/1.3% respectively for the pathological findings.

#### **CONCLUSION**

Sacroiliitis and other SIJ alterations are highly prevalent in individuals younger than 40 years of age with LBP, albeit, majority of these alterations are not recognized nor reported by senior radiologists thus delaying efficacious treatment in spondyloarthritis (SpA) patients.

#### **CLINICAL RELEVANCE/APPLICATION**

Increased awareness for SIJ alterations on lumbar spine CTs may allow for earlier diagnosis and therapy in young SpA patients leading to improved quality of life and deterring irreversible changes.

#### **SSQ13-06 Pixel-by-Pixel Arterial Spin Labeling Blood Flow Pattern Variation Analysis for Depiction of Rheumatoid Synovitis**

Thursday, Dec. 3 11:20AM - 11:30AM Location: E451A

#### **Participants**

Taro Sakashita, Sapporo, Japan (*Presenter*) Nothing to Disclose  
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Michihito Kono, Obihiro, Japan (*Abstract Co-Author*) Nothing to Disclose  
Tatsuya Atsumi, MD, PhD, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose  
Minghui Tang, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

To evaluate noninvasively hyperemia of inflamed synovial tissue (pannus) of rheumatoid arthritis (RA), the arterial spin labeling (ASL) blood flow pattern variation (BFPV) map, which is the post labeling delay (PLD) time-independent variation in relative blood flow pattern, is introduced. The purpose of this prospective study was to test the feasibility of the BFPV map to distinguish pannus from other tissues.

#### **METHOD AND MATERIALS**

Eight patients (7 women and 1 man) with RA of the wrist or finger joints participated in the study. Dynamic contrast-enhanced LAVA sequences for detecting the extent of pannus formation as gold standard and 3D pulsed continuous ASL (pCASL) sequences (repetition time/echo time 4397-4852/10.704 ms, slice thickness 4 mm, number of slices 36, labeling duration 1450 ms, PLD 1025,2025 ms) for quantitative assessment of tissue perfusion were applied at 3 T (GE MEDICAL SYSTEMS, DISCOVERY MR750w). Pixel-by-pixel temporal changes of relative blood flow per PLD time were calculated from pCASL perfusion images with two different PLD times and were imaged as BFPV map. BFPV values of the radial or ulnar artery, pannus, and surrounding tissue were measured and compared by the Tukey test. Color-coded BFPV maps for quantifying pannus volume were imaged by setting threshold values on the BFPV map. The independent t-test was used to analyze pannus volume between two groups of patients classified depending on whether or not pannus formation was detected on the dynamic images.

#### **RESULTS**

There was a statistically significant difference in the BFPV values between artery and pannus, pannus and surrounding tissue, and artery and surrounding tissue ( $p < 0.001$ ) because of the advantage of precise tissue characterization related to the blood flow pattern of the labeled arterial spins. The patients showing apparent pannus formation showed a significantly larger volume of pannus on the color-coded BFPV map than the patients showing no or limited pannus formation ( $p = 0.023$ ).

#### **CONCLUSION**

This approach may be capable of depicting the extent of the synovial disease quantitatively and noninvasively without the need to determine the appropriate PLD time to allow the label to reach the tissue of interest.

#### **CLINICAL RELEVANCE/APPLICATION**

Pixel-by-Pixel Arterial Spin Labeling Blood Flow Pattern Variation introduced in this study may be capable of evaluating the extent of the synovial disease quantitatively and noninvasively.

#### **SSQ13-07 Detection of Synovitis in Rheumatoid Arthritis and Differentiation to Healthy Volunteers by Means of a 2D Optical Imaging System in Comparison to MRI**

Thursday, Dec. 3 11:30AM - 11:40AM Location: E451A

##### **Participants**

Jan Neumann, MD, Munich, Germany (*Presenter*) Nothing to Disclose  
Klaus Thuermel, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose  
Ernst J. Rummeny, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose  
Reinhard Meier, MD, PhD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

To prospectively compare an Indocyanine Green (ICG)-enhanced fluorescence optical imaging (FOI) system and contrast-enhanced 3T MRI with a composite reference consisting of MRI, FOI and clinical examination for the detection of synovitis in the hands of patients with rheumatoid arthritis and the differentiation to healthy volunteers.

#### **METHOD AND MATERIALS**

20 Patients (90% female, mean age = 59.1) with moderate to severe rheumatoid arthritis and 13 healthy volunteers (60% female, mean age = 26) were clinically examined and scanned with FOI (mivenion GmbH, Germany) and 3T MRI (Philips, Netherlands). The degree of inflammation in the metacarpophalangeal, proximal and distal interphalangeal joints of both hands on FOI and MRI was graded objectively by three independent radiologists on a 4-point-ordinate scale (0: no inflammation, 1: mild, 2: moderate, 3: severe) according to the OMERACT RAMRIS score. Results were compared using a composite reference consisting of MRI, FOI and clinical examination.

#### **RESULTS**

Evaluating 2862 joints of 20 patients and 13 volunteers using a composite reference, OI had a sensitivity of 51.5% and a specificity of 90.7%, MRI had a sensitivity of 77.4% and a specificity of 88.8% and clinical examination had a sensitivity of 42.7% and a specificity of 90.2% for the detection of synovitis.

#### **CONCLUSION**

The evaluated ICG enhanced OI system showed limitations in the detection of synovitis in patients with RA.

#### **CLINICAL RELEVANCE/APPLICATION**

Despite its advantages of its minimal invasiveness, lower costs and easy operability the OI system appears to be of limited value for the clinical routine.

#### **SSQ13-08 MRI-detected Markers of Inflammation Especially in Overweight Persons Increase Risk of Incident Osteoarthritis: The POMA Study**

Thursday, Dec. 3 11:40AM - 11:50AM Location: E451A

##### **Participants**

Frank W. Roemer, MD, Boston, MA (*Presenter*) Chief Medical Officer, Boston Imaging Core Lab LLC Research Director, Boston Imaging Core Lab LLC Shareholder, Boston Imaging Core Lab LLC  
Ali Guermazi, MD, PhD, Boston, MA (*Abstract Co-Author*) President, Boston Imaging Core Lab, LLC; Research Consultant, Merck KgaA; Research Consultant, Sanofi-Aventis Group; Research Consultant, TissueGene, Inc; Research Consultant, OrthoTrophic; Research Consultant, AstraZeneca PLC



Michael Hannon, Oakland, PA (*Abstract Co-Author*) Nothing to Disclose  
Tomoko Fujii, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Robert Boudreau, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Kent C. Kwok, MD, Pittsburgh, PA (*Abstract Co-Author*) Advisory Panel, Pfizer Inc Data Safety Monitoring Board, Novartis AG

## PURPOSE

To assess whether presence of inflammation measured as joint effusion and Hoffa-synovitis differs between normalweight, and overweight/obese persons that develop incident OA two years prior the diagnosis of radiographic OA and to assess whether risk of OA differs for men and women.

## METHOD AND MATERIALS

We studied 355 knees drawn from the Osteoarthritis Initiative study that developed incident ROA. They were matched 1:1 by gender, age, and baseline Kellgren-Lawrence grade to a control knee. MR images were acquired at 3 T systems. MRIs were read for Hoffa- and effusion-synovitis at the visit two years prior to incidence defined as P-2. Subjects were classified as normal weight (BMI < 25), overweight (BMI ≥25 and <30) or obese (BMI ≥ 30) at OAI enrollment. Bivariate logistic regression was used to assess the risk of synovitis and effusion at P-2 in subjects (N = 225 cases) that developed radiographic OA comparing overweight and obese subjects to normal weight subjects as the reference. Conditional logistic regression (N = 218 matched pairs) was used to assess the risk of ROA for the interaction of synovitis at P-2 and BMI category stratified by gender.

## RESULTS

For men and women combined, among those who developed ROA there was no increased risk of synovitis in the combined overweight/obese BMI subgroup but being overweight was associated with an increased risk of effusion (OR 2.21, CI 1.11, 4.43). The distribution for the different categories for women was 31.7%, 35.3% and 33.0%. Using overweight women without synovitis as the reference, obesity without synovitis was associated with a greater risk of OA (OR 2.87, CI 1.21,6.83) in women, as was being overweight with synovitis (OR 3.26, CI 1.39, 7.65). For men, these associations were not found. Table 1 gives a detailed overview of these results.

## CONCLUSION

For those who would develop OA, an increased risk of effusion was observed for the combined overweight/obese group at P-2 but not for synovitis. In regard to interaction of BMI with synovitis, the presence of synovitis increases risk of ROA in overweight women while obese women had an increased risk for ROA without synovitis.

## CLINICAL RELEVANCE/APPLICATION

Presence of inflammation seems to play a role especially in overweight women whereas obese women have an increased risk for ROA even in the absence of imaging markers of inflammation confirming that both mechanical load and inflammation play a role in OA incidence at least for women.

## Honored Educators

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Ali Guermazi, MD, PhD - 2012 Honored Educator

## SSQ13-09 Ultrashort TE Evaluation of Osteochondral Junction Alterations in Early Osteoarthritis

Thursday, Dec. 3 11:50AM - 12:00PM Location: E451A

### Participants

James MacKay, MBBCHIR, MRCP, Norwich, United Kingdom (*Presenter*) Nothing to Disclose  
Samantha B. Low, MBChB, Norwich, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Andoni P. Toms, FRCR, PhD, Norwich, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate the characteristics of the osteochondral junction (OCJ) in individuals with possible early osteoarthritis (OA) compared with normal controls using ultrashort echo time (UTE) MR imaging. The OCJ has been implicated in the pathogenesis of OA.

## METHOD AND MATERIALS

Ten healthy controls (group 1) and ten patients aged between 40-50 years old with possible early OA (non-traumatic knee pain, but no conventional radiographic or MR features of OA - group 2) underwent 3T MR imaging of the knee using a 2D UTE sequence. UTE has shown the ability to depict the normal OCJ as a high signal intensity (SI) linear structure. Qualitative grading of the UTE high SI line at the medial (MT) and lateral tibial (LT) plateau OCJ was performed (present/focally or diffusely absent). Quantitative analysis involved creating regions of interest (ROI) at the MT OCJ, LT OCJ and in the femoral metaphysis (background ROI). The peak OCJ SI ratio was calculated by measuring the peak SI across the OCJ ROIs using averaged craniocaudal SI profiling, then dividing by the mean SI of the background ROI to standardize between studies. MT and LT peak OCJ SI ratios were compared between groups using Mann-Whitney tests. Measurements were performed by two independent observers, with reliability assessed using the intraclass correlation coefficient (ICC).

## RESULTS

A high SI line at the OCJ was visualized at the MT and LT of all group 1 subjects. This was focally or diffusely absent in 5/10 group 2 participants at the MT and 4/10 group 2 participants at the LT. There was a significant difference ( $p < 0.001$ ) in MT peak OCJ SI ratio between group 1 (mean  $\pm$ SD = 0.85  $\pm$ 0.10) and group 2 (0.77  $\pm$ 0.12). There was no significant difference ( $p = 0.19$ ) in LT peak OCJ SI ratio between group 1 (0.81  $\pm$ 0.23) and group 2 (0.80  $\pm$ 0.13). The technique demonstrated substantial interobserver reliability, with ICC = 0.65 (95% CI 0.53-0.74).

## CONCLUSION

Qualitative and significant quantitative differences in the UTE appearance of the MT OCJ were seen in individuals with possible OA compared with normal controls.

#### **CLINICAL RELEVANCE/APPLICATION**

Quantitative UTE analysis has potential as a biomarker of early OA by detecting early pathological changes at the OCJ.

SSQ01

## Breast Imaging (MR Diagnostics)

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



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

Discussions may include off-label uses.

### Participants

Linda Moy, MD, New York, NY (*Moderator*) Nothing to Disclose  
Janice S. Sung, MD, New York, NY (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ01-01 Correlation between MR Imaging and Level of Tumor Infiltrating Lymphocyte (TIL) in Triple Negative Breast Cancer (TNBC)

Thursday, Dec. 3 10:30AM - 10:40AM Location: E450A

### Participants

Su Hee Baek, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
You Jin Ku, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Eun Young Chae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Triple negative breast cancer (TNBC) is a heterogeneous disease with varying prognosis. Recently, the importance of tumor-infiltrating lymphocyte (TILs) has been determined. That is, increased TIL positively correlated with the pathologic complete response rate and increased patient survival. The purpose of this study is to investigate associations between TIL and magnetic resonance (MR) imaging in TNBC.

### METHOD AND MATERIALS

This retrospective study was approved by the institutional review board, and informed consent was waived. From February 2006 to December 2014, 112 consecutive women (mean age; 47 years, range ; 25-73 years) with TNBC who had undergone MR imaging were selected. All lesions were evaluated according to Breast Imaging Reporting and Data System (BI-RADS) lexicon by two radiologists. Apparent diffusion coefficient (ADC) values, lymph node involvement and multifocality were also assessed. According to the level of TIL, we divided into two groups: low TIL ; <50% and high TIL ; 50-100%. Associations between TIL and imaging features were evaluated. Statistical analysis was performed by using independence test.

### RESULTS

One hundred twelve malignant lesions (range, 9-73mm; mean, 27.8mm) were evaluated, of which 62 (55.4 %) were in low TIL and 50 (44.6%) were in high TIL. Tumors with high TIL shows more round shape (n = 23, 46%), circumscribed margin (n = 38, 76%), homogenous enhancement (n = 16, 32%) and absence of multifocality (n = 44, 88%) (p <0.005). Low TIL group shows more irregular shape (n = 43, 69.3%), not circumscribed margin (n = 49, 79.0%), heterogeneous enhancement (n = 47, 75.8%) and multifocality (n = 44, 70.9%) (p <0.005). All lesions show typical washout kinetic findings of malignancy without significance. ADC value was higher in high TIL group without reaching significance.

### CONCLUSION

MR imaging features of round shape, circumscribed margin, homogenous enhancement and lack of multifocality are typical pattern of TNBC with high TIL.

### CLINICAL RELEVANCE/APPLICATION

TNBC with high TIL shows characteristic features and it may provide added diagnostic benefit in identifying TNBC with relatively good prognosis.

#### SSQ01-02 Contralateral Parenchymal Enhancement in DCE-MRI of Patients with Unilateral Node-negative ER+/HER2-breastcancer: Potential Value for Chemotherapy Selection

Thursday, Dec. 3 10:40AM - 10:50AM Location: E450A

### Participants

Bas H. van der Velden, MSc, Utrecht, Netherlands (*Presenter*) Nothing to Disclose  
Claudette E. Loo, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Ruud Pijnappel, MD, PhD, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Kenneth G. Gilhuijs, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Low parenchymal enhancement in the contralateral breast at dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) has been associated with inferior invasive disease-free survival (IDFS) of patients with estrogen-receptor positive and human-epidermal-growth-factor-receptor-2 negative (ER+/HER2-) breast cancer. The aim of this retrospective study is to explore whether contralateral parenchymal enhancement has complementary value to existing guidelines to identify patients who may benefit from

chemotherapy.

## METHOD AND MATERIALS

Between 2000 and 2008, 531 consecutive patients eligible for breast-conserving therapy based on conventional imaging and physical examination received a preoperative DCE-MRI in study context. Two-hundred-and-sixty-five patients had ER+/HER2- breast cancer and negative lymph nodes, of whom 66 received hormonal therapy. Forty-two of these patients did not receive chemotherapy. In this group, high-risk and low-risk patients for IDFS were identified based on parenchymal enhancement in the contralateral breast, using a previously reported method. In short, parenchyma was automatically segmented in 3D, enhancement was calculated as the mean of the top-10% of the relative signal increase over time, which was associated with IDFS. The MRI-based risk groups were compared with the Dutch guidelines for systemic therapy based on Adjuvant! Online. Kaplan-Meier estimators and log-rank tests were used.

## RESULTS

The average age at diagnosis in the subgroup treated with hormonal therapy without chemotherapy was 58 years (range: 35-79). The median follow-up was 86 months (range: 37-146). An event occurred in 4/42 (10%) patients. Twenty-one patients (50%) were in the high-risk MRI group. All events occurred in this group ( $P=.034$ ). Thirty-three patients (88%) were indicated for chemotherapy based on the Dutch guidelines, which was not found to be specific for IDFS ( $P=.320$ ). Eighteen patients (43%) were in the high-risk MRI group and were indicated by the guidelines, containing all events ( $P=.009$ ).

## CONCLUSION

Parenchymal enhancement in the contralateral breast may have potential as a prognostic biomarker to complement clinical indication for chemotherapy in patients who receive hormonal therapy.

## CLINICAL RELEVANCE/APPLICATION

Contralateral parenchymal enhancement may have prognostic potential to complement clinical indication for chemotherapy in node negative ER+/HER2- breast cancer patients receiving hormonal therapy.

## SSQ01-03 Characterization of Breast Lesion Kinetics with Accelerated DCE-MRI Using Conventional Sampling Methods

Thursday, Dec. 3 10:50AM - 11:00AM Location: E450A

### Awards

#### Trainee Research Prize - Resident

#### Participants

Federico Pineda, BS, Chicago, IL (*Presenter*) Nothing to Disclose  
Keiko Tsuchiya, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Hiroyuki Abe, MD, Chicago, IL (*Abstract Co-Author*) Consultant, Seno Medical Instruments, Inc  
Milica Medved, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Shiyang Wang, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Xiaobing Fan, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
David V. Schacht, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Aytakin Oto, MD, Chicago, IL (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV; ;  
Gillian M. Newstead, MD, Chicago, IL (*Abstract Co-Author*) Medical Advisory Board, Bayer AG; Consultant, Three Palm Software LLC; Consultant, VuCOMP, Inc; Medical Advisor, Quantitative Insights, Inc  
Gregory S. Karczmar, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To characterize the kinetics of breast lesions in DCE-MRI with high temporal resolution during the first minute post contrast injection using conventional sampling methods.

## METHOD AND MATERIALS

23 women with known enhancing lesions (17 malignant and 18 benign lesions) underwent a combined high temporal/standard protocol DCE-MRI. Patients were imaged on a Philips Achieva 3T-TX with a bilateral breast coil and a protocol consisting of 8 fat-suppressed fast acquisitions after injection of contrast media (0.1mM/kg MultiHance) followed by 5 fat-suppressed 'standard' acquisitions. Temporal resolution for the fast scans was 6.2-9.9s, with spatial resolution of  $1.5 \times 1.5 \times 3 \text{mm}^3$ ; standard protocol temporal resolution was 58-79s and  $0.8 \times 0.8 \times 1.6 \text{mm}^3$  spatial resolution. Percent signal enhancement data were fit to a 2-parameter (uptake only) empirical mathematical model (EMM). Time-of-arrival (TOA) was defined as the time at which a lesion enhanced by 20%, relative to the time when arterial enhancement in the breast first reached 20%. Time to 90% of maximum enhancement (T90) and initial area under the contrast curve (iAUC) were calculated from the EMM parameters. Lesion conspicuity was defined as the ratio of lesion signal increase to background parenchymal enhancement (BPE).

## RESULTS

Significant differences ( $p < 0.005$ ) between benign and malignant lesions were measured for: uptake rate, initial slope, iAUC, TOA, and T90. The average TOA of malignant lesions was  $7.2 \pm 3.7\text{s}$ , and  $25 \pm 18.7\text{s}$  for benign lesions. T90 was  $50 \pm 34\text{s}$  and  $191 \pm 127\text{s}$  for malignant and benign lesions respectively. Average initial uptake rate was  $34 \pm 64\%/s$  for malignancies and  $2 \pm 3\%/s$  for benign lesions. Lesion conspicuity was highest in 4th fast time-point when its average was 11:1, compared to 4.4:1 by the final fast acquisition.

## CONCLUSION

Malignant lesions, on average, had significantly faster signal enhancement than benign lesions, and significantly shorter TOA. Fast sampling may show larger differences between benign and malignant lesions compared to conventional DCE-MRI, and allows measurement of kinetics relative to arterial TOA. Lesion conspicuity was highest at early times after injection, before the sampling of the center of k-space in standard protocols.

## CLINICAL RELEVANCE/APPLICATION

Fast sampling allows accurate measurement of early lesion kinetic parameters, which may be diagnostically useful. Higher lesion

Fast sampling enables accurate measurements of early lesion kinetic parameters, which may be diagnostically useful. Higher lesion conspicuity in early fast images may be beneficial in cases with marked BPE.

#### Honored Educators

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Aytekin Oto, MD - 2013 Honored Educator

#### SSQ01-04 Novel Informatics Modeling Using Clinical and Radiological Imaging Metrics for Characterization of Breast Tumors with the OncotypeDX Gene Array

Thursday, Dec. 3 11:00AM - 11:10AM Location: E450A

##### Participants

Michael A. Jacobs, PhD, Baltimore, MD (*Presenter*) Research Grant, Siemens AG  
Katarzyna J. Macura, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Christopher Umbricht, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Vishwa Parekh, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Riham H. El Khouli, MD, PhD, Silver Spring, MD (*Abstract Co-Author*) Nothing to Disclose  
Antonio C. Wolff, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, F. Hoffmann-La Roche Ltd

#### PURPOSE

Emerging data on breast cancer suggest that different breast cancer subtypes (phenotypes) may respond differently to available adjuvant therapies. Optimal use of established and novel imaging methods, such as multiparametric magnetic resonance imaging (MRI) can simultaneously identify key functional parameters and provide unique imaging phenotypes of breast cancer. We have developed a new informatics tool that integrates clinical variables, derived from imaging and clinical workup, to compare with the 21-gene array assay, OncotypeDX, which stratifies patients into three risk groups: low, medium, and high risk.

#### METHOD AND MATERIALS

We tested our informatics modeling in a group of 86 patients who were ER+ and candidates for the OncotypeDX gene array test and underwent breast MRI imaging at 3T. The clinical and imaging parameters included, breast density, morphology, lesion volume, mass enhancement, Ki-67, Pharmacokinetic (PK)-DCE MRI, ADC mapping, and others. There were 36 patients with OncotypeDX gene array scores of low risk (0-17), 40 patients with intermediate risk (18-31), and 10 patients with high risk (>31). Our non-linear dimensionally reduction (NLDR) informatics algorithm computes the similarity matrix using a hybrid k-means algorithm. We then employed multidimensional scaling to embed the similarity matrix into a two-dimensional representation via random forest decision trees to model the clinical parameters to the risk groups. T-tests were used to determine statistical significance.

#### RESULTS

There was no age difference (51-56y/o) between groups. The PK-DCE parameters, Ktrans for the high and intermediate risk groups were higher (0.45 and 0.50 (1/min)) compared to the low-risk group (0.35 (1/min)) with similar results for the extra vascular fraction (EVF). The ADC values for high and intermediate risk groups were significantly lower than those for the low-risk group (1.09 vs 1.38x10<sup>-3</sup>mm<sup>2</sup>/s). However, the ADC values in glandular tissue were similar across all groups (2.14-2.17x10<sup>-3</sup>mm<sup>2</sup>/s). These results are visualized in our novel informatics heat map.

#### CONCLUSION

The most important surrogate imaging and histological parameters determined from the informatics model were the ADC values, the PK-DCE parameters, lesion size, Ki-67, and breast lesion volume.

#### CLINICAL RELEVANCE/APPLICATION

Informatics modeling of clinical and radiological variables can provide the foundation to relate these variables to the OncotypeDX gene array score.

#### Honored Educators

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Katarzyna J. Macura, MD, PhD - 2012 Honored Educator

Katarzyna J. Macura, MD, PhD - 2014 Honored Educator

Riham H. El Khouli, MD, PhD - 2012 Honored Educator

#### SSQ01-05 The Impact of Pre-operative Breast MRI on Surgical Waiting Time

Thursday, Dec. 3 11:10AM - 11:20AM Location: E450A

##### Participants

Michelle Zhang, MD, Montreal, QC (*Presenter*) Nothing to Disclose  
Simon Sun, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Ann E. Aldis, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Sarkis Meterissian, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Benoit D. Mesurolle, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The purpose of this project is to assess the impact of pre-operative breast MRI on surgical waiting time (defined as from the time of biopsy to the time of surgery), and to identify possible factors contributing to the delay in management, specifically in a publicly

funded healthcare system.

## METHOD AND MATERIALS

This is a retrospective cohort study that includes 1265 patients. Patients evaluated for pre-operative planning for newly diagnosed breast cancer from 2007 to 2013 at a tertiary center were divided into 2 groups: those who had a pre-operative MRI and those who did not (control group). Linear regression using matched populations was then used to compare the surgical waiting time between the 2 patient groups. Potential influences on surgical waiting time and subgroup analysis of the pre-operative MRI patient group were obtained using median regression analysis and Kruskal-Wallis test respectively.

## RESULTS

There was a statistically significant increase ( $p < 0.001$ ) in the surgical waiting time for the MRI group, after matching for confounding characteristics such as age, pathology and surgeon. The mean surgical waiting time for patients having had a pre-operative breast MRI was 57.9 days (95% CI: 55.6-60.1) compared to the control group which was 47.0 days (95% CI: 45.1-48.9). Increased surgical waiting time was associated with more favorable pathology (i.e. DCIS), later year of diagnosis (e.g. 2013 vs. 2007) and older patient age. Second-look ultrasound and subsequent biopsies were also associated with a statistically significant increase in surgical waiting time ( $p=0.001$ ). Within the different subgroups of patients who underwent pre-operative MRI, surgical waiting time was mostly affected by the waiting time from MRI to the time of surgery, rather than from time of cancer diagnosis to MRI ( $p<0.0005$ ).

## CONCLUSION

Pre-operative breast MRI increased surgical waiting time on average from 47.0 to 57.9 days. The waiting time length also correlated with histology, year of diagnosis, patient's age and second-look US/biopsy. A main contributor to the waiting time was the delay between completion of the MRI to surgery, rather than from the delay between initial diagnosis to MRI.

## CLINICAL RELEVANCE/APPLICATION

Pre-operative breast MRI in a publicly funded system may increase surgical waiting time; this increase is in large part due to the wait time from MRI to surgery, rather than the MRI waitlist time.

## SSQ01-06 Integrated Axillary Lymph Node (ALN) Screening during Pre-operative Breast MRI

Thursday, Dec. 3 11:20AM - 11:30AM Location: E450A

### Participants

Sabine M. Detering, Aachen, Germany (*Presenter*) Nothing to Disclose  
Simone Schradig, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Timm Dirrachs, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Christiane K. Kuhl, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

According to the ACOSOG Z001 trial, axillary lymph node dissection (ALND) does not improve survival in women with positive sentinel lymph nodes (SLN). Therefore, an increasing number of women with positive SLNB do not proceed to ALND. However, this could lead to (axillary) relapse in patients with undetected advanced ALN disease. Purpose of this study was to analyze whether a short additional pulse sequence, integrated into our routine pre-operative breast MRI protocol, is sufficient to detect such ALN disease.

## METHOD AND MATERIALS

218 women with biopsy-proven invasive breast cancer underwent preoperative MRI at 1.5 T. The standardized protocol included a pre-contrast coronal T1w-TSE-sequence acquired with the system's built-in body coil and prescribed to cover the axilla, TR/TE 550/15ms, FOV: 370 mm, scan time: 3 min. Two radiologists rated the likelihood of ALN metastasis on a 4 point scale ranging from 1 = definitely absent to 4 = definitely positive. Results of axillary surgery served as standard of reference.

## RESULTS

Histology revealed that 80/218 (37%) patients were node-positive, 138/218 (63%) were node-negative. Of the 80 node-positive, 52 (65.0%) were staged pN1 (up to 1-3 ALN with micromets or 1 macrometastasis  $> 2$  mm), whereas 28 (35.0%) had significant nodal disease, defined as all pN stages  $> pN1$ . Of the 28 patients with significant nodal disease, MRI classified 25 (89.3%) correctly as node positive. Stratified by nodal stages, MRI had a sensitivity of 7% (1/15) for pN1mic, 54% (22/41) for pN1a-c, 86% (12/14) for pN2 and of 100% (10/10) for pN3. MRI correctly excluded presence of ALN metastases in 127/138 patients (specificity: 92.0%).

## CONCLUSION

A fast, 3-minute, additional T1-w MRI of the axilla as part of routine pre-operative breast MRI seems useful for complimentary staging of the axilla in addition to SLNB: MRI has predictably a poor sensitivity for ALN micrometastases - i.e. information on disease that is needed for accurate stage categorization, but not requiring specific treatment, and information that will be provided by SLNB. SLNB alone will, in turn, be unable to detect clinically significant ALN disease outside the sentinel node - a task that appears to be accomplished by MRI.

## CLINICAL RELEVANCE/APPLICATION

A fast MRI of the axilla, as part of routine pre-operative breast MRI, seems suitable to complement SLNB in order screen the axilla for clinically important axillary node disease.

## SSQ01-07 Kinetic Analysis of the Ultra Early Phase on Breast MRI: Comparison between Benign and Malignant Lesions using Ultrafast Dynamic Contrast Enhanced MRI

Thursday, Dec. 3 11:30AM - 11:40AM Location: E450A

### Participants

Hiroyuki Abe, MD, Chicago, IL (*Presenter*) Consultant, Seno Medical Instruments, Inc  
Naoko Mori, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose

Keiko Tsuchiya, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Kirti M. Kulkarni, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Deepa Sheth, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
David V. Schacht, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Federico Pineda, BS, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Gregory S. Karczmar, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate the kinetic data of benign and malignant breast lesions in ultra early phase after contrast injection, using a whole breast ultrafast scanning technique.

## METHOD AND MATERIALS

15 patients (10 benign and 10 malignant breast lesions) were scanned with an acquisition protocol of Ultrafast MRI, consisting of 5 pre and 8 post-contrast bilateral, fat-suppressed T1 weighted images of whole breasts, with temporal resolution of 7 second followed by four regular whole breast acquisitions with temporal resolution of 75 second with Philips Achieva 3T-TX with a dedicated 16 channel bilateral breast coil. Spatial resolution of the ultrafast scan was  $1.5 \times 1.5 \times 3 \text{ mm}^3$ ; for the standard protocol spatial resolution was  $0.8 \times 0.8 \times 1.6 \text{ mm}^3$ . Kinetic curves of each lesion during the ultrafast phase (0 - 56 sec) were assessed with a commercially available CAD system (Dynacad) in terms of initial enhancement ratio (IER), peak enhancement ratio (PER) and curve shape (persistent, plateau, or wash-out). IER was obtained at the second phase after the lesion was visualized. To make the kinetic curve, the time-point for the early phase was set at the second phase after the lesion was visualized, and the late phase was set at the last phase of ultrafast scan.

## RESULTS

Statistically significant differences between benign and malignant lesions were obtained. IER of benign lesions ranged from 32% to 117% (mean 68%), and that of malignant lesions ranged from 107% to 241% (mean 149%) ( $p < .001$ ). PER ranged from 48% to 163% (mean 107%), and that of malignant lesions ranged from 147% to 268% (mean 184%) ( $p < .001$ ). As for curve shape, all benign lesions showed persistent type kinetics except for one lesion that had plateau type kinetics. For malignant lesions, 6 had persistent type kinetics and 3 had plateau type kinetics.

## CONCLUSION

Kinetic analysis of the ultra early phase is useful for differentiation between benign and malignant lesions.

## CLINICAL RELEVANCE/APPLICATION

Ultrafast MRI, which is less influenced by background parenchymal enhancement, could be more clinically useful with the inclusion of kinetic assessment.

## SSQ01-08 Prediction of Indolent Hormone Receptor-Positive Breast Cancer Using Perfusion Parameters and Apparent Diffusion Coefficient

Thursday, Dec. 3 11:40AM - 11:50AM Location: E450A

### Participants

SoHee Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Ki Chang Shin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Eun Young Chae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To investigate whether perfusion parameters and apparent diffusion coefficient (ADC) were useful for the prediction of indolent tumor with very favorable prognostic factors.

## METHOD AND MATERIALS

This prospective study was approved by institutional review board and the informed consent was obtained. We enrolled 87 patients with 91 tumors patients (mean, 49.6 years; range, 29-74 years) who underwent definitive surgery. We defined estrogen receptor-positive tumors with low histologic grade, low Ki67 (<14%), and negative lymph node metastasis as an indolent tumor. We compared these indolent tumors (n=33; 36%) with the others (n=58; 64%) using perfusion and diffusion parameters. Statistical analysis was performed using Fisher's exact test, Chi-square test, and t test. Receiver operating characteristic (ROC) curve and logistic regression analysis was performed to evaluate the diagnostic performance of perfusion and diffusion parameters for the prediction of indolent tumors.

## RESULTS

On univariate analysis, wash-in and iAUCqualitative values were significantly different according to the histologic grade, estrogen receptor, HER-2, Ki67 and lymphovascular invasion ( $P < .05$  for all variables). ADCdiff was significantly different according to the histologic grade, HER-2, and Ki67 ( $P = .010$ ,  $.007$ , and  $.013$ ). On multivariate analysis, Ktrans, iAUCqualitative, and ADCdiff were the significant variables for the prediction of indolent tumors, and the AUC was 0.78, which was higher than those of individual parameter. Mean ADC was positively correlated with wash-out ( $r = 0.350$ ,  $P = .001$ ), and negatively correlated with Kep ( $r = -0.207$ ,  $P = .048$ ). ADCdiff was positively correlated with wash-in ( $r = 0.263$ ) and iAUCqualitative ( $r = 0.245$ ) ( $P = .012$  and  $.019$ ), respectively.

## CONCLUSION

The prediction model using Ktrans, iAUCqualitative, and ADCdiff on DCE-MRI and DWI could be helpful for the identification of indolent tumors and may be used as an imaging biomarker to guide treatment plan.

## CLINICAL RELEVANCE/APPLICATION

Prediction of indolent tumors with very favorable prognostic features using preoperative breast MRI could help oncologists or

surgeons to decide the treatment plan such as neoadjuvant endocrine therapy or immediate surgery omitting chemotherapy.

## **SSQ01-09 Early-stage Invasive Breast Cancer: Association of Tumor Apparent Diffusion Coefficient Values with Axillary Lymph Node Metastasis**

Thursday, Dec. 3 11:50AM - 12:00PM Location: E450A

### **Participants**

Jin You Kim, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Shinyoung Park, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
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Ji Won Lee, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Suk Kim, MD, Pusan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### **PURPOSE**

To evaluate any association between tumor apparent diffusion coefficient (ADC) values and axillary node metastasis in early-stage breast cancer.

### **METHOD AND MATERIALS**

The institutional review board approved this retrospective study, and waived the need for informed consent. Between May 2013 and November 2014, the records of 270 patients (mean age, 51.3 years; range, 23-85 years) with stages T1 and T2 breast cancer (mean tumor size, 2.2 cm; range, 0.5-5.0 cm) who underwent preoperative breast magnetic resonance imaging, including diffusion-weighted (DW) imaging with b values of 0 and 1,000 s/mm<sup>2</sup> were reviewed. The ADC values of the breast tumors were measured and compared with clinicopathological variables. Receiver operating characteristic (ROC) curve and multivariate regression analyses were used to test the predictive power of the tumor ADC values with regard to axillary node metastasis.

### **RESULTS**

Of the 270 patients, 58 (21.5%) experienced axillary lymph node metastasis. The mean tumor ADC values were significantly lower in patients with axillary node metastasis versus those without metastasis ( $0.880 \times 10^{-3}$  vs.  $0.999 \times 10^{-3}$  mm<sup>2</sup>/s;  $P < 0.001$ ). A ROC curve demonstrated a tumor ADC value of  $0.991 \times 10^{-3}$  mm<sup>2</sup>/s to be the optimal cut-off for predicting axillary node metastasis. Multivariate regression analysis revealed that lower tumor ADC value ( $\leq 0.991 \times 10^{-3}$  mm<sup>2</sup>/s; adjusted odds ratio (OR) = 5.861,  $P < 0.001$ ) was an independent variable associated with axillary node metastasis, along with large tumor size ( $> 2$  cm; adjusted OR = 3.156,  $P = 0.002$ ) and presence of lymphovascular invasion (adjusted OR = 4.125,  $P < 0.001$ ). When tumor ADC value was added to known risk factors (i.e., tumor size and lymphovascular invasion) a significant improvement in the accuracy of risk prediction for axillary node metastasis was shown (c-statistic = 0.758 vs. 0.816,  $P = 0.026$ ).

### **CONCLUSION**

Tumor ADC values obtained at DW imaging may be an independent predictive factor for axillary lymph node metastasis in patients with early-stage breast cancer.

### **CLINICAL RELEVANCE/APPLICATION**

In early-stage breast cancer, tumor ADC values may be a predictor of axillary node metastasis, which may assist selection of therapeutic strategies regarding management of axillary nodes.



**Genitourinary (Benign and Malignant Gynecological Diseases)**

Thursday, Dec. 3 10:30AM - 12:00PM Location: E450B



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

**Participants**

Harris L. Cohen, MD, Memphis, TN (*Moderator*) Nothing to Disclose  
Mindy M. Horrow, MD, Philadelphia, PA (*Moderator*) Spouse, Director, Merck & Co, Inc

**Sub-Events****SSQ10-01 Fractal Analysis of the Leiomyoma before Uterine Artery Embolization Using Contrast-Enhanced MRI and Its Effect on the Outcome**

Thursday, Dec. 3 10:30AM - 10:40AM Location: E450B

**Participants**

Nagy N. Naguib, MD, MSc, Frankfurt Am Main, Germany (*Presenter*) Nothing to Disclose  
Nour-Eldin A. Nour-Eldin, MD, PhD, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose  
Tatjana Gruber-Rouh, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose  
Thomas Lehnert, MD, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose  
Renate M. Hammerstingl, MD, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose  
Stefan Zangos, MD, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose  
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To test whether fractal analysis of the leiomyoma using contrast-enhanced MRI correlates with the leiomyoma volume before and after uterine artery embolization (UAE) and with the percentage change at 3 month follow-up enabling its usage as a prognostic factor for treatment success.

**METHOD AND MATERIALS**

The study was retrospectively performed on 33 females (Mean Age: 44.85 +/- 3.95) with 64 leiomyomas. For fractal analysis; MRI images were exported and converted into 8-Bit greyscale images. The greyscale images were then loaded into the computer program ImageJ and analysis was performed using the FracLac plugin. The analysis was performed using the differential-box-counting method at 12 different grid positions. The Mean Fractal dimension for each leiomyoma was calculated by drawing a ROI around each leiomyoma. On the other hand the volume of each leiomyoma was calculated before and 3 months after UAE using contrast-enhanced MRI. The correlation between the mean Fractal dimension of each leiomyoma and its volume before and after UAE as well as the percentage change in leiomyoma volume was tested for statistical significance using Spearman-Rank Correlation test.

**RESULTS**

The mean Fractal Dimension of all leiomyomas was 1.0622 +/- 0.1472 (Range: 0.74 - 1.31). The mean leiomyoma volume before UAE was 97.38 ml +/- 160.86 (Range: 1.65 - 987.34). At follow-up the mean leiomyoma volume was 68.08 ml +/- 138.3 (Range: 0.15 - 875.05). The mean percentage volume change at follow-up was 52.54% [reduction] +/- 26.99 (Range: 40.05%[increase] - 96.57%[reduction]). A statistically significant strong positive correlation between the mean fractal dimension of each leiomyoma and its volume before and after UAE was observed ( $\rho = 0.77$ ,  $p < 0.0001$  and  $\rho = 0.78$ ,  $p < 0.0001$  respectively). A statistically significant strong negative correlation between the mean fractal dimension of each leiomyoma and its percentage volume change at 3 month follow-up was noted ( $\rho = -0.68$ ,  $p < 0.0001$ ).

**CONCLUSION**

The smaller the mean fractal dimension of a leiomyoma before UAE the higher will be the percentage volume reduction at 3 month follow-up after UAE.

**CLINICAL RELEVANCE/APPLICATION**

Leiomyomas with low mean fractal dimension tend to have a significantly better response at 3 month follow-up following UAE. Hence fractal dimension can be used as a prognostic factor for patient selection.

**SSQ10-02 Color Doppler Evaluation Of Utero-Ovarian Circulation In Polycystic Ovarian Syndrome and Its Correlation With Hormonal and Biochemical Parameters**

Thursday, Dec. 3 10:40AM - 10:50AM Location: E450B

**Participants**

Shivi Jain, MD, Varanasi, India (*Presenter*) Nothing to Disclose  
Akanksha Singh, MD, Varanasi, India (*Abstract Co-Author*) Nothing to Disclose  
Madhu Jain, MD, Varanasi, India (*Abstract Co-Author*) Nothing to Disclose  
Ram C. Shukla, MD, MBBS, Varanasi, India (*Abstract Co-Author*) Nothing to Disclose  
Ashish Verma, MBBS, MD, Varanasi, India (*Abstract Co-Author*) Nothing to Disclose  
Arvind Srivastava, Varanasi, India (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To find out the variations in utero-ovarian circulation and their association with various endocrinal and biochemical parameters in women with Polycystic Ovarian Syndrome (PCOS).

## METHOD AND MATERIALS

65 patients of reproductive age group who had clinical and biochemical findings suggestive of PCOS by Rotterdam criteria (2003) were selected for TVS with Color Doppler study in early follicular phase (3rd-5th day of menstrual cycle). 58 age-matched women with normal clinical and biochemical parameters were taken as controls. The RI (Resistance Index), PI (Pulsatility Index) and PSV (Peak Systolic Velocity) of ovarian stromal and uterine arteries were assessed after the estimation of LH, LH: FSH ratio, free testosterone level, fasting Insulin level and fasting glucose:insulin ratio.

## RESULTS

The mean value of LH, LH: FSH, free testosterone and fasting glucose:insulin ratio was significantly higher ( $p < 0.001$ ) in PCOS patients in comparison to control (LH  $7.95 \pm 1.34$  vs  $5.60 \pm 0.51$ ; LH: FSH  $1.93 \pm 0.17$  vs  $1.16 \pm 0.22$ ; free testosterone  $3.63 \pm 0.40$  vs  $1.71 \pm 0.31$ ; fasting glucose:insulin ratio  $4.0 \pm 0.60$  vs  $7.51 \pm 0.49$ ). The mean ovarian stromal RI, PI and PSV in PCOS was significantly lower ( $p < 0.001$ ) as compared to control ( $0.43 \pm 0.08$ ,  $0.58 \pm 0.10$ ,  $11.41 \pm 2.53$  vs  $0.79 \pm 0.21$ ,  $0.86 \pm 0.03$ ,  $9.40 \pm 0.73$  respectively). Similarly, uterine artery PI was significantly higher ( $p < 0.001$ ) in PCOS when compared to control ( $3.05 \pm 0.45$  vs  $2.43 \pm 0.31$ ). There was significantly negative correlation of ovarian stromal RI with serum LH: FSH ratio ( $r = 0.617$ ,  $p < 0.01$ ). The Uterine artery PI positively correlated with LH: FSH ratio ( $r = 0.548$ ,  $p < 0.01$ ), free testosterone ( $r = 0.532$ ,  $p < 0.01$ ), fasting Insulin ( $r = 0.414$ ,  $p < 0.01$ ), fasting glucose:insulin ratio ( $r = 0.484$ ,  $p < 0.01$ ) and inversely with ovarian stromal RI ( $r = 0.410$ ,  $p < 0.01$ ).

## CONCLUSION

Hormonal dysfunction is responsible for hemodynamic changes in utero-ovarian circulation in patients with PCOS. Ultrasonography along with color Doppler plays a significant role in the diagnosis and monitoring of Polycystic Ovarian Syndrome.

## CLINICAL RELEVANCE/APPLICATION

The decreased PSV and increased PI and RI of uterine artery may explain recurrent early abortions in PCOS. Significant negative correlation between ovarian stromal RI and LH: FSH ratio confirms hormonal dysfunction.

### SSQ10-03 Contrast Enhanced 3D STIR T2-Weighted SPACE in Evaluating Sacral Nerve Plexus in Pelvic Endometriosis: Compared with Conventional 2D Sequence

Thursday, Dec. 3 10:50AM - 11:00AM Location: E450B

#### Participants

Xiaoling Zhang, Guangzhou, China (*Presenter*) Nothing to Disclose  
Meizhi Li, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose  
Jian Guan, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose  
Mingjuan Liu, MMed, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose  
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Huanjun Wang, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To prospectively evaluate microstructural abnormalities in sacral nerve plexus in women with pelvic endometriosis at 3.0T MRI.

#### METHOD AND MATERIALS

Twenty women with clinically diagnosed pelvic endometriosis and 20 age-matched healthy women were enrolled in this study. In addition to conventional coronal 2D T2WI TSE imaging, contrast enhanced coronal 3D STIR T2-weighted SPACE was obtained to produce multiplanar (MPR) images. All examinations were assessed independently by two radiologists for the infiltration of the sacral plexus by endometriotic lesions and the abnormal anatomical features of the sacral plexus. Agreement between 2D- and 3D-sequences and inter-observer-agreement was evaluated using kappa-statistics.

#### RESULTS

The sacral nerve roots in healthy subjects and patients were clearly visualized on both sequences. The diameter of the sacral nerve roots in patients was larger than in the control group. Most of the patients with endometriosis displayed local thickening or indistinction in the fibers of sacral plexus. There were no significant difference between the results of the 2 radiologists ( $F = 2.563$ ,  $P = 0.086$ ). Contrast enhanced 3D STIR T2-weighted SPACE was preferable in evaluating sacral nerve plexus in pelvic endometriosis than regular 2D sequences.

#### CONCLUSION

Changes of the microarchitecture of the sacral nerve plexus were revealed in the patients with pelvic endometriosis on MRI. Contrast enhanced 3D STIR T2-weighted SPACE can display the infiltration of scral nerve fibers by endometriotic lesions and the abnormal anatomical features of scral nerve plexus.

#### CLINICAL RELEVANCE/APPLICATION

Contrast enhanced 3D STIR T2-weighted SPACE was applied as a method of magnetic resonance neurography to reveal the correlation between the changes of scral plexus and chronic pelvic pain in patients with pelvic endometriosis .

### SSQ10-04 MRI-US Fusion Imaging in Real-Time Virtual Sonography for the Evaluation of Pelvic Endometriosis: Preliminary Study

Thursday, Dec. 3 11:00AM - 11:10AM Location: E450B

#### Participants

Valeria Vinci, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Lucia Manganaro, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Silvia Bernardo, MD, Rome, Italy (*Presenter*) Nothing to Disclose  
Matteo Saldari, MD, PhD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Maria Eleonora Sergi, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

Federica Capozza, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Real-time virtual sonography (RVS) is a new technique that uses magnetic navigation and computer software for the synchronized display of real-time US and multiplanar reconstruction MRI images. The purpose of this study was to evaluate the feasibility and ability of RVS to detect pelvic endometriosis.

## METHOD AND MATERIALS

This study was conducted over a two-month period in march-april 2015 on 25 patients referred for a Clinical and US suspect of endometriosis. Patients underwent pelvic MRI at 3 T and fusion imaging was offered (Hitachi HI Vision Ascendus) . The MRI image dataset acquired at the time of the examination was loaded into the fusion system and displayed together with the US image on the same monitor. Both sets of images were then manually synchronized and image were registered using multiple planes MR imaging.

## RESULTS

2patients had endometriosis of the vescico-uterine pouch, with urinary symptoms associated.7patients had endometriosis of the middle compartment mainly shown as ovarian endometriomas in 6 cases and adenomyosis in 3 cases.19had signs of endometriotic implants in the posterior compartment shown as fibrotic plaque over the serosal surface of the uterus and rectum in 12 cases. In 1 case there was a deep infiltrating intestinal endometriosis over the rectum. A retroflexed uterus was associated in 6 cases. 6 cases showed fibrotic strands between the uterus and the rectum with thickening of the uterosacral ligaments.Regarding endometriosis of the medial compartment, there was an overlap of data of 100% between MRI and RVS, both appearing superior to a standard US evaluation.Endometriosis of the vescico-uterine pouch was better visualized in MRI.Fibrotic strand were displayed in both methods with an overlap of 100%; on the contrary, relying on RVS it was more difficult to differentiate between active plaque and predominantly fibrotic plaque because of the difficulty in visualizing the hemorrhagic foci. However the infiltration of the bowel wall was better undressed in RVS.

## CONCLUSION

Thanks to information from both US and MRI, fusion imaging allows better identification of the pelvic implants, superior to the standard US evaluation.

## CLINICAL RELEVANCE/APPLICATION

Thanks to information from both US and MRI, fusion imaging allows better identification of the pelvic implants, superior to the standard US evaluation.

## SSQ10-05 Diagnostic Value of MR Imaging to Diagnose Adnexal Torsion

Thursday, Dec. 3 11:10AM - 11:20AM Location: E450B

### Participants

Sophie Beranger-Gibert, Paris, France (*Abstract Co-Author*) Nothing to Disclose

Hajer Sakly, Paris, France (*Abstract Co-Author*) Nothing to Disclose

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Marc J. Bazot, MD, Paris, France (*Abstract Co-Author*) Nothing to Disclose

Emile Darai, Paris, France (*Abstract Co-Author*) Nothing to Disclose

Isabelle Thomassin-Naggara, MD, Paris, France (*Presenter*) Speakers Bureau, General Electric Company; Research Consultant, Olea Medical

## PURPOSE

To retrospectively evaluate the diagnostic performance of MR imaging for the diagnosis of adnexal torsion (AT) in a series of patients with an equivocal adnexal mass at ultrasonography in a context of acute or sub acute pelvic pain.

## METHOD AND MATERIALS

Our institutional ethics committee approved the study and granted a waiver of informed consent. All patients with acute or sub-acute pelvic pain undergoing MR exam for the exploration of an equivocal adnexal mass (January 2007 to December 2012) with surgical exploration or clinical and radiological follow up at least of 3 months were retrospectively included (n=58). Three radiologists blinded to the clinical, ultrasonographic and surgical data retrospectively and independently reviewed MR images. Features associated with AT were identified using univariate and recursive partitioning multivariate analysis.

## RESULTS

Twenty-two patients (38%) had a diagnosis of AT. The accuracy of MR image interpretation by each reader was 83.8% (26/31), 90.3% (28/31), 83.8% (26/31) in a context of acute pelvic pain and 92.5% (25/27), 88,8% (24/27), 81.5% (22/27) in a context of sub acute pelvic pain for reader 1, 2 and 3 respectively. On multivariate analysis, whirlpool sign (OR=6.5 [1.36-31], p=0.01) and a thickened tube (OR=8.2 [1.2-56.8], p=0.03) were associated with adnexal torsion, with substantial inter-reader agreement (kappa 0.71-0.84, and 0.82-0.86, respectively). The presence of adnexal hemorrhagic content helps to predict ovarian viability (p=0.009)

## CONCLUSION

MR imaging is an accurate technique for the diagnosis of adnexal torsion in the setting of patients with adnexal mass having acute or sub acute pelvic pain.

## CLINICAL RELEVANCE/APPLICATION

MR imaging is an accurate second line technique to diagnose adnexal torsion without any pelvic irradiation with the ability to predict ovarian viability without any gadolinium injection.

## SSQ10-06 Can Diffusion-weighted MR Imaging Differentiate Uterine Sarcomas from Leiomyomas?

Thursday, Dec. 3 11:20AM - 11:30AM Location: E450B

## Participants

Jun Gon Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Chan Kyo Kim, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jung Jae Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Byung Kwan Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Differentiation uterine sarcoma from leiomyoma is a major challenge. The aim of this study was to investigate the utility of diffusion-weighted imaging (DWI) in differentiating uterine sarcomas from leiomyomas.

## METHOD AND MATERIALS

Between January 2010 and August 2014, 188 patients with surgically confirmed 38 uterine sarcomas (16 leiomyosarcomas, 12 malignant mixed Mullerian tumors, 9 endometrial stromal sarcomas, and 1 undifferentiated pleomorphic sarcoma) and 150 leiomyomas were enrolled in this retrospective study. All patients underwent preoperative routine pelvic MR imaging at 3T, including DWI. DWI was obtained using a STIR single-shot echo-planar imaging technique with background suppression ( $b=0$  and  $1000$  s/mm<sup>2</sup>). The apparent diffusion coefficient (ADC) and signal intensity on T2-weighted imaging (T2SI) were calculated in the tumors, normal myometrium and gluteus muscle. In the differentiation of sarcomas from leiomyomas, various parameters (ADC, diffusion restriction, tumor-myometrium or gluteus muscle contrast ratio [TCRm or TCRg] on T2-weighted imaging, necrosis, hemorrhage, and size) were evaluated.

## RESULTS

The mean ADC values of sarcomas ( $0.939 \pm 0.253$ ) were statistically lower than those of leiomyomas ( $1.347 \pm 0.327 \times 10^{-3}$ mm<sup>2</sup>) ( $p < 0.001$ ). For differentiating sarcomas from leiomyomas, the parameters including diffusion restriction, T2SI, TCRm, TCRg, necrosis and hemorrhage were statistically significant (all  $p$ -values  $< 0.001$ ). At receiver operating characteristics curve analysis, the area under the curves of diffusion restriction and ADC in differentiating sarcomas from leiomyomas were 0.902 and 0.860, respectively and were statistically greater than other parameters (TCRm, TCRg, necrosis, hemorrhage and size) ( $p < 0.05$ ): with a cutoff ADC value of  $1.111 \times 10^{-3}$ mm<sup>2</sup>, the sensitivity and specificity were 79% and 80%, respectively. For the degree of diffusion restriction, sarcomas showed moderate or strong in 97% (37/38), while leiomyomas revealed absent or mild in 69% (104/150).

## CONCLUSION

DWI at 3T may be a useful technique for the differentiation of uterine sarcomas from leiomyomas.

## CLINICAL RELEVANCE/APPLICATION

As a noninvasive technique, preoperative DWI at 3T can be used to predict sarcomas in patients with uterine myometrial masses, which may give potential for planning treatment strategies.

## SSQ10-07 Variations in Reporting Recommendations for Son Graphically Evaluated Endometrial Stripe in Post Menopausal Bleeding in a Subspecialty Practice

Thursday, Dec. 3 11:30AM - 11:40AM Location: E450B

## Participants

Aoife Kilcoyne, MBBCh, Boston, MA (*Presenter*) Nothing to Disclose  
Avinash R. Kambadakone, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Colin J. McCarthy, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Giles W. Boland, MD, Boston, MA (*Abstract Co-Author*) Principal, Radiology Consulting Group; Royalties, Reed Elsevier  
Susanna I. Lee, MD, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Debra A. Gervais, MD, Chestnut Hill, MA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Endometrial cancer is the most common gynecologic cancer in the United States. Early diagnosis and intervention is imperative to improve prognosis and survival. In the setting of postmenopausal vaginal bleeding (PMB), sonographically determined endometrial stripe thickness is an established criteria for predicting risk of cancer and thereby serving as a guide to trigger endometrial sampling. Current guidelines recommend tissue sampling for endometrial stripe measuring  $>5$ mm, however, there is limited data on adherence to these guidelines. The purpose of this study was to evaluate the variability in reporting recommendations for sonographically determined endometrial stripe thickness measuring 5mm in patients with PMB at a subspecialty practice in an academic teaching institution.

## METHOD AND MATERIALS

In this ongoing study, we performed a review of the 'RENDER' radiology database to identify pelvic ultrasound exams performed on women aged 18-80years between January 1st 2009 and December 31st 2014 for evaluation of PMB. Using natural language processing, the radiology reports of these exams were then analysed for endometrial stripe thickness, reporting patterns in the body, impression of radiology report and the recommendations, if any. The search terms used for the focused search included 'endometrial stripe', '5mm', 'postmenopausal'. The variations in the reporting recommendations based on the endometrial stripe thickness were then evaluated.

## RESULTS

Of the 253 reports reviewed, 58 (24.6%) were not relevant - the search identified patients with an endometrial stripe of greater or less than 5mm. In 74 reports (29.2%), no recommendation was made. In 73 reports (28.8%), endometrial biopsy was recommended. Other recommendations included: biopsy or imaging 14 (6%), no intervention 11 (4%), further imaging 8 (3%), gynaecology review 4 (2%), gynaecology review and biopsy 4 (2%), follow-up imaging 2 (1%).

## CONCLUSION

In a subspecialty abdominal imaging practice at an academic institution, considerable variation exists on the reporting recommendation for evaluation of PMB with endometrial stripe thickness measuring 5mm with only 30% of reports adhering to established guidelines.

## CLINICAL RELEVANCE/APPLICATION

The findings of this study highlight the need for development of standardised approaches/tools to bring about clarity in terms of management options/further investigation of abnormal endometrial thickening in the setting of postmenopausal bleeding.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Debra A. Gervais, MD - 2012 Honored Educator  
Susanna I. Lee, MD, PhD - 2013 Honored Educator

## SSQ10-08 Cystic Adnexal Lesions Analyzed by International Ovarian Tumor Analysis (IOTA) Criteria in Routine Clinical Practice

Thursday, Dec. 3 11:40AM - 11:50AM Location: E450B

### Participants

Claire E. Beaumont, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Jessica B. Robbins, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Elizabeth A. Sadowski, MD, Madison, WI (*Presenter*) Nothing to Disclose  
Mark A. Kliewer, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Lisa Barroilhet, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Laura Huffman, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Katherine E. Maturen, MD, Ann Arbor, MI (*Abstract Co-Author*) Consultant, GlaxoSmithKline plc; Medical Advisory Board, GlaxoSmithKline plc

### PURPOSE

The simple rules developed by the IOTA group direct management of adnexal cysts based on sonographic imaging features. The diagnostic performance of these criteria in routine practice has not been formally evaluated since the original study was published in 2010. The goal of our research is to determine how well the IOTA simple rules criteria perform in stratifying cystic lesions and detecting ovarian cancer in routine radiology practice.

### METHOD AND MATERIALS

Patient consent was waived for this IRB approved retrospective review of transvaginal US studies on non-pregnant post-menarchal women performed between January-March 2011. Adnexal cysts larger than 3 cm were evaluated according to the IOTA rules. The incidence of benign adnexal lesions, borderline tumors and ovarian carcinoma was calculated. Surgical pathology, resolution on follow-up imaging and/or normal gynecological pelvic examination at 2 years were the accepted end points.

### RESULTS

108 lesions in 104 women met inclusion criteria. Mean age=41±14 years; range=13-84. 3 lesions (2.8%) met simple rule 1 (malignant): 30% (1/3) were cystadenomas and 30% (1/3) carcinoma, with no borderline tumors. 95 lesions (88%) met simple rule 2 (benign): 10.5% (10/95) were benign ovarian neoplasms (dermoids=2; cystadenomas=8), with no borderline tumors or carcinomas. 10 lesions (9.2%) met simple rule 3 (indeterminate): 20% (2/10) were benign ovarian neoplasms, 20% (2/10) borderline tumors, and 10% (1/10) carcinoma. Thus, the IOTA rules gave a definitive (non-indeterminate) result in 98/108 (90.7%) of cases and correctly triaged 100% of borderline and malignant neoplasms either to further imaging evaluation or surgery.

### CONCLUSION

The results of this pilot study indicate that the IOTA rules successfully detect borderline and malignant neoplasms. However, the vast majority of lesions in routine practice are benign in both sonographic appearance and clinical behavior. Full and nuanced evaluation of diagnostic performance in routine clinical practice will require a larger number of cancers, to be evaluated in our ongoing research.

## CLINICAL RELEVANCE/APPLICATION

The IOTA simple rules were able to detect borderline and malignant ovarian neoplasms in our clinical practice and aided in directing women with such lesions to oncologic specialists.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Katherine E. Maturen, MD - 2014 Honored Educator

## SSQ10-09 MR Imaging and Semi-automated Texture analysis for Differentiating Atypical Appearing Uterine Leiomyomas from Leiomyosarcomas

Thursday, Dec. 3 11:50AM - 12:00PM Location: E450B

### Participants

Yuliya Lakhman, MD, New York, NY (*Presenter*) Nothing to Disclose  
Joshua L. Chaim, DO, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Harini Veeraraghavan, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Diana S. Feier, MD, Cluj-Napoca, Romania (*Abstract Co-Author*) Nothing to Disclose  
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Ramon E. Sosa, BA, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Debra A. Goldman, MS, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Chaya Moskowitz, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Robert Soslow, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Nadeem Abu-Rustum, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Hedvig Hricak, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Evis Sala, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## **PURPOSE**

To investigate whether qualitative magnetic resonance (MR) imaging features and texture analysis (TA) can distinguish between atypical appearing uterine leiomyomas (ALM) and leiomyosarcomas (LMS)

## **METHOD AND MATERIALS**

Forty-one women with ALM (n=22) or LMS (n=19) at histopathology and MRI between January 1, 2007 and December 31, 2013 were included in this retrospective study. Two readers (R1 and R2), blinded to histopathologic diagnoses, independently evaluated all cases. R2 manually segmented each tumor on axial T2-weighted image. Intensity based gray scale correlation matrix (GLCM) textures and Gabor edge based GLCM textures were computed for each segmented tumor. Relationships between clinical characteristics, imaging features, and histopathology were tested with Fisher's exact test. Each tumor was assigned a score of 0 to 4 based on the total number of most statistically significant features present. Diagnostic accuracy with exact 95% confidence intervals was calculated for each feature and score. Texture features were analyzed with a random forest (RF) classifier to automatically distinguish ALM from LMS. RF classifier was optimized by varying the number of decision trees and its performance was tested with five-fold cross validation.

## **RESULTS**

Nodular borders, hemorrhagic foci, "T2 dark" areas, and central ( $\pm$ peripheral) unenhanced area(s) were significant predictors of LMS ( $p < 0.0001$  for each feature and reader). Sensitivity and specificity of each feature for LMS were 0.84/0.74 and 0.91/0.86 for nodular borders, 0.95/1.0 and 0.82/0.95 for hemorrhagic foci, 0.84/0.79 and 0.86/0.86 for "T2 dark" areas, and 0.95/1.0 and 0.73/0.68 for central ( $\pm$ peripheral) unenhanced area(s) for R1/R2, respectively. When any 3 of these features were detected in a lesion, the sensitivities and specificities were 1.0/0.95 and 0.95/1.0 for R1/R2, respectively. The best classification accuracy of computer-generated image features was achieved with 25 decision trees (AUC=0.86, sensitivity=0.95, specificity=0.69). The Gabor edge-based texture features were more relevant than the intensity based texture features for the classification.

## **CONCLUSION**

Presence of certain qualitative MRI features can reliably distinguish ALM from LMS. Texture analysis as a semi-automated adjunct may add certainty to the diagnosis of LMS.

## **CLINICAL RELEVANCE/APPLICATION**

MR imaging and semi-automated texture analysis are useful in distinguishing atypical appearing leiomyomas from leiomyosarcoma.

## **Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Evis Sala, MD, PhD - 2013 Honored Educator

SSQ21

## Vascular/Interventional (Improving Education and Outcomes in Interventional Radiology)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E352



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credit: 1.00

### Participants

Kelvin K. Hong, MD, Baltimore, MD (*Moderator*) Scientific Advisory Board, Boston Scientific Corporation;  
Steven M. Zangan, MD, Chicago, IL (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ21-01 Simulation Based Training Improves Resident Skill in Ultrasound-Guided Biopsy

Thursday, Dec. 3 10:30AM - 10:40AM Location: E352

### Participants

Nicholas L. Fulton, MD, Cleveland, OH (*Presenter*) Nothing to Disclose  
Ji Y. Bueth, MD, Cleveland, OH (*Abstract Co-Author*) Research Grant, Galil Medical Ltd  
Jayakrishna Gollamudi, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose  
Mark R. Robbin, MD, Cleveland Hts, OH (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

The purpose of this study was to determine whether ultrasound-guided biopsy simulation training using a high fidelity abdominal imaging phantom can improve the radiology residents' overall technical competence in ultrasound guided biopsy.

### METHOD AND MATERIALS

This is an IRB approved prospective study. Forty radiology residents from a single institution were enrolled and randomized into training (TG) or control (CG) groups. Each resident performed an ultrasound-guided biopsy on a high-fidelity abdominal imaging phantom using a 22-gauge needle. Prior experience in ultrasound guided biopsies (number of months and procedures performed), total procedure time, number of skin punctures, and number of needle adjustments were obtained. Each procedure was evaluated by a blinded board certified radiologist using a 5 point Likert scale technical competence score. The TG cohort received an additional 30 minute simulation training session with an experienced senior resident. The CG cohort received no additional training. Each resident underwent a second procedure and the same metrics were measured. Statistical analysis was performed using independent t tests.

### RESULTS

There were no statistically significant differences between the TG and CG with regards to prior ultrasound-guided biopsy experience. No significant differences between the two cohorts were present in the initial procedure. After the training session, the training cohort demonstrated a statistically significant improvement in overall procedure time (92 seconds less), number of skin punctures (0.8 less), number of needle adjustments (1.4 less), and subjective performance on a 5-point Likert scale (1.1 more) as determined by a blinded grader. The CG did not demonstrate a statistically significant difference in any of the measured metrics between the two procedures.

### CONCLUSION

The use of an abdominal imaging phantom for training radiology residents in ultrasound-guided biopsy performance can improve procedural skills including shorter procedure times, less skin punctures, less needle movements and improved subjective performance by a blinded grader. Additional randomized controlled trials will be necessary to determine the external validity of the study in regards to improved patient outcomes and IR-department turnaround time.

### CLINICAL RELEVANCE/APPLICATION

This study demonstrates the efficacy of simulation training on improving resident performance in ultrasound-guided biopsy.

#### SSQ21-02 Ultrasound Guided Foreign Body Removal (USFBR): Simulation Training and Clinical Implementation Outcomes

Thursday, Dec. 3 10:40AM - 10:50AM Location: E352

### Participants

Veronica J. Rooks, MD, Honolulu, HI (*Abstract Co-Author*) Nothing to Disclose  
Jeffrey M. Meadows, Tripler AMC, HI (*Presenter*) Nothing to Disclose  
Christian L. Carlson, MD, MS, Cibolo, TX (*Abstract Co-Author*) Nothing to Disclose  
Michael V. Krasnokutsky, MD, Olympia, WA (*Abstract Co-Author*) Nothing to Disclose  
Frank E. Mullens, MD, MPH, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose  
Beth M. Haeuptle, BS, MA, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose  
Michael Lustik, Tripler AMC, HI (*Abstract Co-Author*) Nothing to Disclose  
James W. Murakami, MD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose  
William E. Shiels II, DO, Columbus, OH (*Abstract Co-Author*) President, Mauka Medical Corporation; Royalties, Mauka Medical Corporation; Patent holder, Mauka Medical Corporation

### PURPOSE

USFBR can be taught to radiologists in a stepwise approach to generate competency, and radiologists can apply the technique in the patient setting to remove foreign bodies.

## METHOD AND MATERIALS

USFBR was taught to 48 radiologists at 4 hospitals. Training included didactic and hands-on instruction covering 7 components: instrument alignment, hand/transducer position, forceps use, foreign body definition, forceps grasp, recognition of volume averaging, and oblique cross cut artifact. Pre-training testing assessed removal of a single toothpick imbedded in a turkey breast in 15 minutes. Post-training evaluation consisted of 5 toothpick removals. Ongoing clinical implementation of USFBR includes foreign body removal under ultrasound guidance by a trained radiologist. Parameters including age of patient, which radiologist, removal success, type and size of foreign body, incision size, foreign body retention time, reason for removal, symptoms, modalities used in detection, wound closure, and sedation are recorded. Data were analyzed using chi-squared and Fisher's exact tests for categorical outcomes and analysis of variance for continuous outcomes.

## RESULTS

After training, radiologists' scores improved from 21-52% pre-training to 90-100% post-training ( $p < 0.001$  for each component). Clinical to date, USFBR has been 100% successful in 7 (25 expected) patients, ages 9-73 years, by 4 trained radiologists. Objects removal length 4 to 30 mm, retention time 2 to 864 days, incision 2 to 8 mm. 1 closure. 1 sedated.

## CONCLUSION

Ultrasound guided foreign body removal approach taught in simulation improves radiologist technique and removal outcomes. A radiologist who completes simulation training can remove a variety of imbedded foreign bodies.

## CLINICAL RELEVANCE/APPLICATION

USFBR can be used to remove foreign bodies while minimizing patient discomfort and potential tissue damage.

## SSQ21-03 Evaluation of a Gelatin-Based Phantom Model System for Training of CT-Guided Drain Placement

Thursday, Dec. 3 10:50AM - 11:00AM Location: E352

### Participants

Stephen A. Balfour, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Pratik S. Patel, DO, Philadelphia, PA (*Presenter*) Nothing to Disclose  
Xi Xue, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Justin McCloskey, BA, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
David S. Pryluck, MD, MBA, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Prior studies have described the use of low-cost gelatin phantom models to train ultrasound-guided procedures, however, there is limited data evaluating their use in training CT guided procedures. The purpose of this study is to evaluate the use of such a model to train inexperienced operators to perform CT guided abscess drainages.

## METHOD AND MATERIALS

Twenty inexperienced and blinded participants were asked to place a needle into a simulated abscess in a gelatin phantom followed by a pigtail catheter using Seldinger technique. Subjects were randomized to receive traditional didactic instruction prior to testing or to receive hands-on training with the phantom model prior to testing. Primary endpoints included time to successful needle, wire, and drain placement, number of scans to achieve needle placement, and total number of scans. Secondary endpoints included a Likert-type confidence survey.

## RESULTS

Experimental subjects required fewer scans to achieve needle placement (4.7 vs 9.2,  $p = 0.04$ ) and less time to achieve needle placement (14.7 vs 20.4 minutes,  $p = 0.04$ ), compared with control subjects. Experimental subjects also felt more confident in their ability to safely ( $p = 0.03$ ) and successfully ( $p = 0.01$ ) perform the procedure on an actual patient. There was no significant difference between groups for total number of scans and time to successful wire/drain placement.

## CONCLUSION

Our data demonstrate that the use of low-cost gelatin phantom models for the training of CT-guided procedures improves both performance and confidence in technically inexperienced subjects with the potential to reduce radiation dose.

## CLINICAL RELEVANCE/APPLICATION

We believe gelatin phantom simulation has real potential to serve a larger role in medical student and resident training.

## SSQ21-04 Use of an Electromagnetic Navigation System on a Phantom as a Teaching Modality To Improve Training for CT-Guided Procedures

Thursday, Dec. 3 11:00AM - 11:10AM Location: E352

### Participants

Dmitry Trifanov, MD, Boston, MA (*Presenter*) Nothing to Disclose  
Taj Kattapuram, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Haiyang Tao, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Ronald S. Arellano, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Raul N. Uppot, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The purpose of this study is to evaluate the role of electromagnetic navigational guidance system (EMN) and a phantom as training simulator for computed tomography (CT)-guided procedures.

## METHOD AND MATERIALS

The study included two components: 1. A skills test using a navigational guidance system and phantom that simulated a CT-guided



procedure. 2. A survey of the fellows assessing the use of a navigational guidance system on a phantom as a potential tool to help training for CT-guided procedures. Nineteen fellows (12 interventional radiology fellows and 7 abdominal imaging fellows) were involved in the study.

## RESULTS

Use of the EMN system improved the successful number of attempts at hitting the biopsy target for both the diagnostic and interventional group. Mean number of successful attempts for all the fellows in the manual/conventional CT guidance group was 58.8%. Mean number of successful attempts for all the fellows in the EMN group was 85.9%. Although there was improvement in number of successful attempts using the EMN system compared to manual conventional method, there was no statistically significant difference in time or accuracy. The pre and post survey showed no correlation was found between their confidence and accuracy and only half of the fellows disclosed that their confidence improved after the training session. However 92.9% of the trainees felt that using EMN system and phantom are useful training tools to simulate CT-guided procedures.

## CONCLUSION

Use of EMN system on a phantom is a potentially valuable training tool for training and simulating CT-guided procedures for fellows. When using EMN navigational guidance, the number of the successful attempts by the diagnostic fellows, was significantly better than the interventional fellows. There was significant improvement in number of successful attempts for all fellows when the EMN system was used compared to manual/conventional targeting. In addition, nearly 93% of the fellows reported that use of the CT-simulator helped with training as it helped in understanding the spatial orientation necessary for CT-guided procedures.

## CLINICAL RELEVANCE/APPLICATION

Use of EMN systems on a phantom can help simulate and train residents and fellows for CT-Guided Procedures. These simulated environments can help with patient safety.

## SSQ21-05 Interventional Radiology Fellowship Websites: A Critical Analysis of Content and Accessibility

Thursday, Dec. 3 11:10AM - 11:20AM Location: E352

### Participants

Resmi Charalel, MD, New York, NY (*Presenter*) Nothing to Disclose  
Bradley B. Pua, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Naveen Galla, BA, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Samir Trehan, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
David C. Madoff, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate the content and accessibility of interventional radiology (IR) fellowship program websites.

## METHOD AND MATERIALS

All IR fellowship programs listed on the Society of Interventional Radiology (SIR) website were individually evaluated based on content and ease of access. Upon review of the SIR website, program contact information, application information, program description and website address were evaluated. A Google search was performed ("[program name] interventional radiology fellowship") and the number of mouse clicks required to get from Google to each fellowship website was recorded. Each fellowship website was evaluated for detailed program characteristics, application information and specific contact information. Online data was collected in November 2014.

## RESULTS

Of the 85 programs listed on the SIR website, 95% (81/85) were currently offering fellowships and 96% (78/81) of these programs had functioning websites. All programs listed a contact telephone number and mailing address on the SIR website. However, no program had a functional link to the fellowship website from the SIR website. Via Google, it took an average of 1.1 clicks to access available websites. Program description, application information and rotation schedule were provided in 86% (67/78), 72% (56/78) and 18% (14/78) of websites, respectively. Only 31% (24/78) of programs indicated on their websites that they accepted applications via ERAS. Additional factors such as didactics, current fellow information, and research opportunities were available in 32% (25/78), 15% (12/78), and 33% (26/78), respectively.

## CONCLUSION

The SIR website maintains a comprehensive listing of IR fellowship programs, most of which could be efficiently accessed via Google. While most fellowship program websites contained a program description, other content such as application information and rotation schedule, were less frequently present.

## CLINICAL RELEVANCE/APPLICATION

Interventional radiology (IR) fellowship will soon be replaced by its own residency. During this process, it will be increasingly important to understand the information available to applicants on program websites and how to improve them.

## SSQ21-06 The Impact of a Laser Navigation System (LNS) on CT-guided Interventions

Thursday, Dec. 3 11:20AM - 11:30AM Location: E352

### Participants

Maurice Pradella, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose  
Tobias Heye, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Martin Takes, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
David Buegler, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Christoph J. Zech, MD, Basel, Switzerland (*Abstract Co-Author*) Research Grant, Bayer AG Speaker, Bayer AG Travel support, Bayer AG Advisory Board, Bayer AG Speaker, Bracco Group Travel support, Bracco Group

## PURPOSE

CT-guided biopsies, drainages as well as spinal nerve infiltrations are established minimal-invasive methods. The aim of this study

was to compare our results with a newly installed laser navigation system (LNS) to prior procedures.

## METHOD AND MATERIALS

In June 2014 a new CT scanner (Somatom Edge, Siemens Medical Solutions, Erlangen, Germany) as well as a LNS (Amedo 3D-LNS, Amedo, Bochum, Germany) were installed in our institution. We retrospectively analysed and compared all biopsies, drainages and infiltrations from a 3 months period prior (2013) and after (2014) the installation. Lesion size, distance from skin, procedure duration, radiation dose (total CT DIvol), complications and clinical success were evaluated. Operators experience was categorized between residents under supervision and consultants, with at least 5 years of experience in interventional radiology.

## RESULTS

A total of 236 procedures were included of which 69.1 % were performed by experienced operators (2013: 111 (66.7%), 2014: 125 (91.1%)). In 2014 80.5% of all interventions were performed by using the LNS. Experienced operators used the LNS in 81.3 % of all cases in 2014 vs. 72.7 % for inexperienced operators. There was no overall difference in size (12.4 cm<sup>2</sup> vs. 12.7 cm<sup>2</sup>, p=0.93), duration (10.7 min vs. 10.5 min, p=0.91) or distance from skin (6.1 cm vs. 5.8 cm, p=0.37) between the two groups. Overall complication rate was 6.8 % (with LNS: 4.0 % vs. 8.9 % without LNS, p=0.14). Success rate was 97.0 % incl. 8.1 % unclear cases (96.0 % incl. 10.0% vs. 97.8 % incl. 6.7 %, p=0.46). In total the use of the LNS reduced the patients' radiation exposure by 47.9 % (30.1 mGy vs. 57.9 mGy, p<0.001). This effect was independent from experience (experienced operators: 30.4 mGy vs. 59.2 mGy, p<0.001; inexperienced operator: 26.7 mGy vs. 54.8 mGy, p=0.012). Interestingly the use of the LNS significantly reduced the procedure's duration in the inexperienced group (4.0 min vs. 13.2 min, p=0.046).

## CONCLUSION

Our data suggest that the use of a LNS can reduce the radiation dose significantly. This effect occurs independently from operator's experience. Furthermore there might be benefits in reducing the procedure's duration in the group of inexperienced operators.

## CLINICAL RELEVANCE/APPLICATION

Dose reduction is an important factor in interventional radiology both for the patient as well as for the physician involved.

## SSQ21-07 How Much Does an Interventional Procedure Actually Cost? Analysis Using Time Driven Activity Based Costing

Thursday, Dec. 3 11:30AM - 11:40AM Location: E352

### Participants

Anand M. Prabhakar, MD, Somerville, MA (*Presenter*) Nothing to Disclose  
Derek Haas, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Nicole Bassoff, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Katelyn Brinegar, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
H. Benjamin Harvey, MD, JD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Alexander S. Misono, MD, MBA, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Robert L. Sheridan, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Rahmi Oklu, MD, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Time-driven activity-based costing (TDABC) is a strategic accounting tool that empowers health care systems to determine the cost of care delivery vis-à-vis process mapping. This information can be used to optimize the value of clinical processes and protocols. This project applied TDABC analysis to understand the labor costs of dialysis-related interventional radiology procedures.

## METHOD AND MATERIALS

In this IRB-approved, HIPAA compliant study, 25 patients who presented to IR for fistulagram or dialysis access thrombectomy were observed from arrival to discharge from July-September 2014. The trained observers recorded the room idle time and the time the patient spent with each staff resource throughout the patients stay. This data was used to estimate the average time spent by each staff resource at each step in the care process, and the value per minute of each staff resource (capacitance cost) was calculated using publically available salary information. Based on these two factors, as well as equipment and room costs, the total cost of each procedure was calculated. The data were analyzed with descriptive and comparative statistics.

## RESULTS

Of the patients in the study, 16 underwent a fistulagram and 9 underwent a thrombectomy. The mean times were: 75±49 (room idle time), 25±12 min (prep time), 90±46 min (IR fellow time), 124±46 min (IR Attending time), 15±5 min (room cleaning time), and 142±45 min (total procedure time). Staff utilization rates for thrombectomy and fistulagram were: 47%/32% (IR Attending), 52%/45% (IR Fellow), 67%/66% (IR Nurse), and 74%/75% (IR Technologist). Using salary estimates, the staff capacitance costs were: \$4.10/min (IR Attending), \$1.46/min (IR Nurse), \$1.12/min (IR Tech), and \$0.76/min (IR Fellow). The mean fistulagram cost was \$563±199 with a 3.6x variation between the min (\$302) and max (\$1073) cost and the mean thrombectomy cost was \$1103±430 with a 3.1x variation between the min (\$598) and max (\$1851) cost.

## CONCLUSION

TDABC analysis demonstrates wide variability in the costs associated with dialysis-related procedures. Improvement of staff utilization rates is a strategy for reducing these costs.

## CLINICAL RELEVANCE/APPLICATION

TDABC is a novel way to cost healthcare procedures. Efforts aimed at improving staff utilization could reduce procedural costs for health care systems and increase their likelihood of success under risk-share payment models.

## SSQ21-08 Effect of Patients' Negative Affect on Adverse Events in Interventional Radiology

Thursday, Dec. 3 11:40AM - 11:50AM Location: E352

### Participants

Nadja Kadom, MD, Boston, MA (*Presenter*) Nothing to Disclose

Gheorghe Doros, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

Elvira V. Lang, MD, Brookline, MA (*Abstract Co-Author*) Founder and President, Hypnalgescics, LLC;

### PURPOSE

Self-fulfilling prophecy of thoughts and feelings about health outcomes and the mood contagion between patients and physicians are contested topics in the current literature and lay press. In this study we assessed whether a patient's negative affect is predictive of adverse events during interventional radiological procedures.

### METHOD AND MATERIALS

This IRB-approved HIPAA compliant study includes 230 patients who underwent percutaneous peripheral vascular and renal interventions in a randomized sequence. Prior to their interventions patients filled out the Positive Affect Negative Affect Schedule (PANAS), rating 10 adjectives each related to either positive affect (PA) or negative affect (NA) using a 5-point rating scale ranging from "1=Very slightly/Not at All" to "5=Extremely". Adjectives for NA were: Distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid. Adjectives for PA were: Interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, and active. Adverse events included prolonged hypoxia, hypertensive or hypotensive episodes, prolonged bradycardia, postoperative bleeding. Summary scores for NA and PA were split into high and low over their medians and correlated with absence or presence of adverse events using logistic regression. Odds ratios, standard error (SE), confidence intervals (CI), and p-values were reported using SAS 9.1.3.

### RESULTS

Patients with high NA had significantly more adverse events than those with low NA (22% vs 12%; odds ratio 0.48, SE 0.17, CI 0.23 - 0.97,  $p=0.04$ ). The degree of PA did not significantly affect outcome (odds ratio 0.76, SE 0.27, CI 0.38 - 1.53,  $p=0.44$ ).

### CONCLUSION

Patients with high negative affect fared significantly worse in terms of adverse events as compared to patients who had low negative affect. The degree of positive effect did not make significant difference.

### CLINICAL RELEVANCE/APPLICATION

The mood contagion from the patient's negative affect should be of concern for the practicing interventional radiologist because it may result in a self-fulfilling prophecy of a negative outcome.

## SSQ21-09 Lead Aprons: A Lead Exposure Hazard?

Thursday, Dec. 3 11:50AM - 12:00PM Location: E352

### Participants

Kevin Burns, MD, Bronx, NY (*Presenter*) Nothing to Disclose

Morri Markowitz, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose

Benjamin Taragin, MD, Teaneck, NJ (*Abstract Co-Author*) Nothing to Disclose

Jamie Shoag, BS, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose

Sukhraj Kahlon, BS, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Lead (Pb) is highly toxic but is useful to protect against ionizing radiation. The lead inside shields worn by medical workers has long been believed to be nonhazardous. This study was designed to determine, for the first time, whether such shields expose wearers to lead in dust on exterior shield surfaces.

### METHOD AND MATERIALS

This was a descriptive study of a convenience sample of 172 shields. Both surfaces of each shield were tested in 2 ways: a qualitative on-site test (LeadCheck, 3M) and a lab based quantitative dust sample analysis by atomic absorption spectroscopy (AAS) expressed in micrograms per foot squared ( $\mu\text{g}/\text{ft}^2$ ). Age, type of shield, Pb sheet thickness, storage method and visual and radiographic appearance were assessed.

### RESULTS

86 shields [50% (95% CI: 43-57%)] tested positive for surface lead using the qualitative method on one or both sides. 109 [63% (95% CI: 56-70%)] of the shields had detectable lead by AAS. Pb dust by AAS ranged from undetectable to 998  $\mu\text{g}/\text{ft}^2$ . Comparing assessment methods, the positive predictive value of the qualitative method was 85%; negative predictive value was 58% versus the quantitative method. There was 82% agreement as to the presence of Pb between the 2 sides, e.g., if Pb was present on one surface it was likely present on the other. The quantitative detection of Pb was significantly associated with: 1) visual appearance of the shield (1-best, 3-worst): 90% of shields that scored 3 had detectable dust Pb; 2) type of shield: a greater proportion of the pediatric patient, full body and thyroid shields were positive than vests and skirts; 3) use of a hangar for storage: 4 of 14 shields on hangers (27%) were positive vs. 66 of 105 not on hangers (67%). Radiographic determination of shield intactness, thickness of interior Pb sheets, and age of shield were unrelated to presence of surface dust Pb. Of note, 5/5 shields constructed with no interior Pb had no detectable surface Pb.

### CONCLUSION

63% of shields had detectable surface lead which was associated with visual appearance, type of shield, and storage method. A clinical correlate study, currently in progress at our institution, will help to assess risk to patients and clinicians.

### CLINICAL RELEVANCE/APPLICATION

Lead shields, long thought to be safe, have lead dust on external surfaces. Lead dust is a known source of exposure that can result

in lead poisoning and should be minimized as much as possible.

SSQ08

## ISP: Gastrointestinal (MR Technique)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E353A



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

**FDA** Discussions may include off-label uses.

### Participants

Hero K. Hussain, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose  
Bachir Taouli, MD, New York, NY (*Moderator*) Consultant, Guerbet SA  
Scott B. Reeder, MD, PhD, Madison, WI (*Moderator*) Institutional research support, General Electric Company Institutional research support, Bracco Group

### Sub-Events

#### SSQ08-01 Gastrointestinal Keynote Speaker: New MRI Techniques in the Abdomen

Thursday, Dec. 3 10:30AM - 10:40AM Location: E353A

### Participants

Bachir Taouli, MD, New York, NY (*Presenter*) Consultant, Guerbet SA

#### SSQ08-02 Shortened Breath-hold Contrast-enhanced MRI of the Liver Using a New Parallel Imaging Technique, CAIPIRINHA (Controlled Aliasing in Parallel Imaging Results in Higher Acceleration): A Comparison with Conventional GRAPPA Technique

Thursday, Dec. 3 10:40AM - 10:50AM Location: E353A

### Participants

Masaki Ogawa, Nagoya, Japan (*Presenter*) Nothing to Disclose  
Tatsuya Kawai, MD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hirohito Kan, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose  
Susumu Kobayashi, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yoshihiro Akagawa, Aichi, Japan (*Abstract Co-Author*) Nothing to Disclose  
Kazushi Suzuki, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose  
Shunsuke Nojiri, Aichi, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yoshiyuki Ozawa, MD, PhD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yuta Shibamoto, MD, PhD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Respiratory motion artifact is one of the major causes of image degradation in dynamic contrast-enhanced imaging of the abdomen. The parallel imaging (PI) technique can decrease the acquisition time but lead to PI artifacts and a loss of signal-to-noise ratio (SNR) at a high acceleration factor (AF). They depend heavily on the geometry of the coil array used and various vendor-specific PI reconstruction techniques. The purpose of this study was to examine whether the shortened breath-hold 3-dimensional volumetric interpolated breath-hold examination (3D-VIBE) sequence for high AF using the controlled aliasing in parallel imaging results in higher acceleration (CAIPIRINHA) technique could substitute for the conventional sequence using generalized autocalibrating partially parallel acquisition (GRAPPA) in patients undergoing routine gadoteric acid-enhanced liver MRI.

### METHOD AND MATERIALS

30 patients with clinically suspected focal liver lesions were scanned using 3D-VIBE sequences with GRAPPA with AF=2 and AF=4 and CAIPIRINHA with AF=4 (acquisition times: 21, 14, and 12 seconds, respectively) at the same spatial resolution during the hepatobiliary phase on a 3T MRI scanner. Visual evaluations using a 3- or 5-point scale and SNR analysis were performed for the 3 sequences.

### RESULTS

For CAIPIRINHA with AF=4, there was significantly less image noise in both visual evaluation and SNR analysis and fewer PI artifacts than for GRAPPA with AF=4 ( $P<0.0005$ ); it was equal to GRAPPA with AF=2, and had fewer motion artifacts than GRAPPA with AF=2 and 4 ( $P<0.0012$ ). The liver edge sharpness and hepatic vessel clarity, lesion conspicuity, and overall image quality were rated significantly higher with CAIPIRINHA with AF=4 than GRAPPA with AF=2 and AF=4 ( $P<0.009$ ). For GRAPPA with AF=4, lesion conspicuity and overall image quality were rated significantly lower than for GRAPPA with AF=2 ( $P<0.012$ ).

### CONCLUSION

The shortened breath-hold 3D-VIBE sequence using the new CAIPIRINHA technique with a high AF of 4 was superior to the conventional GRAPPA sequence. The shortened breath-hold sequence using GRAPPA with a high AF of 4 worsened the image quality and lesion conspicuity.

### CLINICAL RELEVANCE/APPLICATION

The shortened breath-hold 3D-VIBE sequence using the CAIPIRINHA with a high AF of 4 can reduce the acquisition time to almost half without significantly increasing image noises and artifacts.

## SSQ08-03 New Quiet MR Sequences in Clinical Routine: First Experience in Abdominal Imaging

Thursday, Dec. 3 10:50AM - 11:00AM Location: E353A

### Participants

Sebastian Fischer, MD, Frankfurt, Germany (*Presenter*) Nothing to Disclose  
Markus Domschke, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose  
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose  
Claudia Frellesen, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose  
Patricia Dewes, MD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose  
Jan-Erik Scholtz, MD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose  
Stefan Zangos, MD, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Purpose of our study was to demonstrate the feasibility and limitations of acoustic noise reduction in a standard clinical MRI protocol for abdominal imaging.

### METHOD AND MATERIALS

The acoustic noise and image quality were assessed for a standard liver imaging protocol including TSE and GRE sequences and compared to a protocol with new quiet optimizations in 17 patients with suspected liver lesions (10 men, 7 women; 58.7±12.0 years). For each sequence the SI, SNR and CNR were measured. Two independent, blinded readers with a different level of training interpreted both examinations, while scoring artefacts, the overall image quality, the delineation of the abdominal organs and the level of confidence in visualization of the anatomy and pathologies. Afterwards a side-by-side comparison for readers' image preference was performed. The means of the sound level measurements, the SI, SNR and CNR was compared in a paired comparative t-test using Holm-Sidak method. The Wilcoxon rank test determined differences in readers ratings and their level of agreement was derived from Spearman correlations.

### RESULTS

Significant reduction of acoustic noise was measured for T2 TSE (-5.16 dBA) and T2 HASTE (-3.75 dBA) and less differences for T1 FLASH (-0.42 dBA) and T1 DIXON (-0.29 dBA). SI, SNR and CNR were significantly lower for quiet T2 TSE (-11.3%, -18.0%, -23.1%) and T2 HASTE (-25.4%, -46.2%, -37.7%) and higher for T1 DIXON (+4.6%, +32.0%, +24.4%). All sequences were independently rated with a comparable image quality and confidence in visualization of the anatomy and pathologies against the standard sequences, except from the quiet T1 FLASH sequences (structure identification -29.5%, diagnostic confidence -37.5%). Accordingly in the side-by-side comparison standard T1 FLASH sequences were strongly preferred against new quiet sequences, while less preference was observed for T2 TSE and T2 HASTE and no difference in T1 DIXON sequences. Inter-rater correlation was  $k=0,987$  with  $p<0.001$ .

### CONCLUSION

An acoustic noise reduction was achieved with the new quiet optimizations while maintaining diagnostic quality and confidence in T2 TSE, T2 HASTE and T1 DIXON sequences. The quiet T1 FLASH sequence seems not to be comparable with regard to image quality and diagnostic confidence.

### CLINICAL RELEVANCE/APPLICATION

The results can be used to render MRI scans more patient-friendly in clinical practice, in particular for young, scared or elderly patients.

## SSQ08-04 Intravoxel Incoherent Motion Diffusion-weighted Imaging is a Better Indicator of High Grade Hepatocellular Carcinoma Than Conventional Apparent Diffusion Coefficient

Thursday, Dec. 3 11:00AM - 11:10AM Location: E353A

### Participants

Shintaro Ichikawa, MD, Chuo-Shi, Japan (*Presenter*) Nothing to Disclose  
Utaroh Motosugi, MD, Yamanashi, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hiroyuki Morisaka, MD, Kofu, Japan (*Abstract Co-Author*) Nothing to Disclose  
Katsuhiko Sano, MD, PhD, Chuo, Japan (*Abstract Co-Author*) Nothing to Disclose  
Tomoaki Ichikawa, MD, PhD, Yamanashi, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hiroshi Onishi, MD, Yamanashi, Japan (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate the utility of intravoxel incoherent motion (IVIM) derived parameters for discrimination of histological grade of hepatocellular carcinoma (HCC). Measurement reproducibility was also studied by assessing inter- and intra-reader variation.

### METHOD AND MATERIALS

Fifty-eight patients with 60 pathologically confirmed HCCs underwent IVIM imaging with 11 b values (0-1000 s/mm<sup>2</sup>). The diffusion parameters, i.e., apparent diffusion coefficient (ADC), slow diffusion coefficient (D), fast diffusion coefficient (D\*), and perfusion fraction (f) were calculated for all HCCs. All measurements were performed by two radiologists, and one of them repeated the measurements after a 4-week interval to minimize memory bias. These parameters were compared between lesions with high and low-to-moderate histologic grade using Wilcoxon test. Further, receiver operating characteristic (ROC) analysis was performed to evaluate the discrimination ability, and inter- and intra-reader agreements were analyzed with intraclass correlation coefficients (ICC).

### RESULTS

The D and D\* values ( $\times 10^{-3}$  mm<sup>2</sup>/s) were both significantly lower in high grade HCC than in low-to-moderate grade HCC for both observers (P < 0.0183) (D = 0.78 vs. 0.98 [reader 1-1st], 0.73 vs. 0.96 [reader 1-2nd], and 0.76 vs. 0.96 [reader 2]; and D\* = 24.5 vs. 39.7 [reader 1-1st], 22.7 vs. 40.7 [reader 1-2nd], and 23.5 vs. 37.0 [reader 2]). The ADC values [ $\times 10^{-3}$  mm<sup>2</sup>/s] measured by reader 1-1st and f (%) measured by reader 1-2nd also showed a statistical difference (ADC = 0.99 vs. 1.14, and f = 27.1 vs. 21.8, P < 0.0129). The ROC analysis demonstrated that the D value had significantly greater Az values than the ADC for

discriminating high grade HCC from low-to-moderate grade HCC (0.859 vs. 0.753 [reader 1-1st], 0.885 vs. 0.635 [reader 1-2nd], and 0.816 vs. 0.651 [reader 2],  $P < 0.047$ ). The inter- and intra-reader ICC values were excellent for D (0.814 and 0.851) and good for other parameters (ADC, 0.786 and 0.732;  $D^*$ , 0.688 and 0.724;  $f$ , 0.689 and 0.623).

## CONCLUSION

The IVIM-derived D values showed a significantly better diagnostic performance than the ADC values in differentiating high grade HCC from low-to-moderate grade HCC. The results by the two readers and repeated measurements by one reader are reproducible, especially for the D value.

## CLINICAL RELEVANCE/APPLICATION

D values derived from IVIM modeling may be helpful in the preoperative differentiation of the histologic grade of HCC,

### SSQ08-05 Quantification of Liver Fibrosis by T1rho MR - Phantom Validation and Pilot In-Vivo Imaging at 3T

Thursday, Dec. 3 11:10AM - 11:20AM Location: E353A

#### Participants

David T. Fetzer, MD, Dallas, TX (*Presenter*) Nothing to Disclose

Xiang He, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

Alessandro Furlan, MD, Pittsburgh, PA (*Abstract Co-Author*) Author, Reed Elsevier; Research Grant, General Electric Company

Kyongtae T. Bae, MD, PhD, Pittsburgh, PA (*Abstract Co-Author*) Patent agreement, Medtronic, Inc; Consultant, Otsuka Holdings Co, Ltd

## PURPOSE

To assess the performance of T1rho MR in noninvasive fibrosis quantification through protein phantom validation, healthy subject reproducibility testing, and liver disease patient imaging.

## METHOD AND MATERIALS

This prospective study was HIPAA-compliant and IRB-approved. T1rho imaging was performed on a Siemens MAGNETOM Trio 3T scanner with a phased-array body coil. Single-slice measurements were obtained using spin-lock preparation ranging from 10-80 msec followed by a balanced steady state free precession readout. T1rho values were calculated by single exponential fitting of the signal decay profile. Phantoms containing various concentrations of polysaccharides and proteins (cross-linked bovine serum albumin) were imaged. 19 healthy subjects (12M, 7F, mean age 30) were recruited; 11 liver disease subjects (8M, 3F, mean age 50) were enrolled following liver biopsy (fibrosis stages F1=2; F2=5; F3=2; F4=2). Correlation (Pearson  $r$ ) was calculated between T1rho value and fibrosis stage, inflammatory grade, and degree of steatosis, as well as time since last meal and days since last alcoholic beverage.

## RESULTS

In phantoms, T1rho values correlated strongly with protein concentration ( $r=0.97$ ), further validating T1rho quantification. Good inter- and intra-subject reproducibility was demonstrated in healthy volunteers. In liver disease subjects, good correlation was found between T1rho and fibrosis stage ( $r=0.74$ ). No significant correlation between T1rho and inflammatory activity was found ( $r=-0.26$ ). There was a moderate negative correlation with degree of steatosis ( $r = -0.66$ ). There was no significant correlation with hours since last meal or days since last drink ( $r=-0.12$  and  $0.16$ , respectively).

## CONCLUSION

T1rho quantification was validated using a protein solution phantom. T1rho hepatic imaging is feasible at 3T in human subjects and values appear unaffected by food or alcohol intake. A positive correlation with fibrosis stage in disease subjects was found.

## CLINICAL RELEVANCE/APPLICATION

T1rho values appear to correlate with macromolecular concentration and may provide an additional tool for noninvasive quantification of fibrosis, an important indicator of chronic liver disease severity.

### SSQ08-06 Rectal Cancer: Short-Term Reproducibility of Intravoxel Incoherent Motion Parameters at 3.0T MR

Thursday, Dec. 3 11:20AM - 11:30AM Location: E353A

#### Participants

Hongliang Sun, MD, Beijing, China (*Presenter*) Nothing to Disclose

Yanyan Xu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

Wu Wang, MD, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate the short-term test-retest reproducibility of IVIM (intravoxel incoherent motion) parameters of rectal cancer at 3.0T MR.

## METHOD AND MATERIALS

Twenty-six patients with rectal cancer who underwent pelvis magnetic resonance imaging including diffusion-weighted imaging using eight b values (0 to 1000s/mm<sup>2</sup>) 30 min apart. IVIM parameters (D, pure diffusion;  $f$ , perfusion fraction;  $D^*$ , pseudo-diffusion coefficient) were calculated by bi-exponential analysis. The values of interobserver IVIM parameters and test-retest parameters were compared by paired t-test or Wilcoxon test. The short-term test-retest reproducibility of IVIM parameters and the interobserver IVIM parameters variation were assessed by measuring repeatability coefficient and Bland-Altman limits of agreements. The repeatability coefficient was calculated as the range of IVIM parameters of two identical measurements for 95% of subjects.  $P < 0.05$  was considered to indicate a statistically significant difference.

## RESULTS

The mean IVIM parameters values (D,  $f$ ,  $D^*$ ) were ( $1.17 \pm 0.39$ ) mm<sup>2</sup>/ms, ( $13.56 \pm 6.74$ ) %, ( $46.76 \pm 77.74$ ) mm<sup>2</sup>/ms, respectively. There were no significant differences in D,  $f$ , or  $D^*$  values within two different observers on the same DW-MR scan ( $p=0.256$ ,

$p=0.088$ ,  $p=0.112$ ), and the corresponding repeatability coefficient and Bland-Altman biases were 11.1%, 55.4%, 40.3%; 1.0%, -8.0%, 2.9%, respectively. The repeatability coefficient and Bland-Altman biases for D, f and D\* were 47.3%, 126.3%, 197.4% and 10.9%, -21.6%, 20.1%, respectively with short-term test and retest DW-MR scan.

## CONCLUSION

Relatively good reproducibility of D value measurement were observed in rectal cancer between short-term test and retest IVIM imaging, compared to f and D\* values. The IVIM parameters (f and D\*) showed large repeatability coefficient and extent of 95% confidence interval. More efforts should be invested to improve the measurement reproducibility of IVIM parameters in rectal cancer.

## CLINICAL RELEVANCE/APPLICATION

The Intravoxel Incoherent Motion (IVIM)-derived parameters are increasingly used for clinical management decisions in rectal cancer. However intravoxel incoherent motion (IVIM) parameters (f and D\*) showed worse measurement reproducibility compared to D. In serial DW-MRI for rectal cancer evaluation such as treatment response, measurement variations should be considered.

## SSQ08-07 Semi-quantitative Assessment of Respiratory Motion Compensation Techniques in T2-weighted Abdominal MR Imaging Using a Novel MRI-compatible Motion Platform

Thursday, Dec. 3 11:30AM - 11:40AM Location: E353A

### Participants

Alberto Diaz de Leon, MD, Dallas, TX (*Presenter*) Nothing to Disclose  
David T. Fetzer, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
Qing Yuan, PhD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
Joris Nofiele, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
Takeshi Yokoo, MD, PhD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose  
Gaurav Khatri, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
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April A. Bailey, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
Rajiv Chopra, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
Ivan Pedrosa, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

For T2-weighted (T2) fast spin echo imaging of the abdomen, multishot (MSFSE) may be preferred over faster single shot (SSFSE) because of superior contrast-to-noise, increased sharpness and spatial resolution. However, studies evaluating the effect of motion on T2W strategies are lacking. Our goal was to assess the effects of respiratory motion on various k-space sampling and motion compensation approaches, utilizing a novel motion-simulating platform.

### METHOD AND MATERIALS

Respiratory waveforms were recorded in a healthy volunteer by tracking diaphragm excursion during breath-hold, diaphragmatic drift, cough, and free-breathing. Waveforms were used to drive a computer-controlled MRI-compatible motion platform. Using a 3T Philips Ingenia and a 32-element phased-array coil, T2 axial images of a torso phantom were acquired during simulated respiratory motion using SSFSE, interleaved (iMSFSE) and sequential (sMSFSE) MSFSE, and a new MultiVane XD (MVXD) acquisitions. These were repeated during simulated free breathing without and with respiratory trigger (RT) and navigator (NAV) motion compensation. Three fellowship-trained radiologists, blinded to acquisition used, independently assessed motion artifacts, clarity of edges, signal uniformity, slice registration, and overall quality using a 5-point scale. Scores for each radiologist were normalized and analyzed by one-way ANOVA for equality of mean scores between acquisitions.

### RESULTS

Imaging scores during breath-hold and cough showed no significant differences between acquisitions. During diaphragmatic drift and free breathing (without/with RT and NAV), SSFSE scores of motion artifacts, signal uniformity, and overall quality were superior to those of iMSFSE and sMSFSE, and statistically different ( $p<0.01$ ). MVXD had better scores than iMSFSE and sMSFSE for all categories with RT and for motion artifact and signal uniformity with NAV, and these differences were significant ( $p<0.01$ ).

### CONCLUSION

Our novel MRI-compatible motion phantom allows detecting differences in the effects of respiratory motion in various k-space sampling and respiratory compensation techniques for T2W abdominal MRI. SSFSE and novel acquisitions such as MVXD resulted in better image quality scores.

### CLINICAL RELEVANCE/APPLICATION

Phantom motion simulation studies enable systematic quality assessment of MR acquisitions during motion and facilitate development and validation of new motion-compensated MR imaging techniques.

## SSQ08-08 Is 3D Non-rigid Registration Necessary in Hepatic DCE-MRI: A Repeatability Study

Thursday, Dec. 3 11:40AM - 11:50AM Location: E353A

### Participants

Hongwei Liang SR, PhD, Nantong, China (*Presenter*) Nothing to Disclose  
Fei Xing, Nantong, China (*Abstract Co-Author*) Nothing to Disclose  
Jian Lu, Nantong, China (*Abstract Co-Author*) Nothing to Disclose  
Peng Cao, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To investigate necessity of three-dimensional non-rigid registration application in hepatic dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) by the pharmacokinetic parameters' repeatability.

### RESULTS



There is significant difference between means of discrepant pixels' value pre and post registration data in same slice ( $t=2.637, p<0.05$ ). RPD box chart showed that mean of inter- and intra [Ktrans], [kep] and [Ve] of lesion, liver and sacrospinal muscle after registration was smaller than that before registration. Outliers and extreme value were reduced or disappeared for most pharmacokinetic parameters in pre and post registration comparison, with the exception of the [Ve] from liver in interobserver comparison (number of outliers pre/post- registration: 0/3) and [kep] from lesion in intraobserver comparison (number of outliers pre/post- registration: 2/3). Repeatability of [Ktrans] and [kep] measured from lesion, liver and sacrospinal muscle was improved after registration in both inter- and intra-measurements. Concordance correlation coefficient (CCC) of [Ktrans], [kep], [Ve] obtained from lesion, sacrospinal muscle was augmented in post -registration group than that of in pre group (for example, CCC of interobserver comparison pre/post- registration: 0.5561/0.8510).

## CONCLUSION

The 3D non-rigid registration is relatively useful to improve the repeatability of pharmacokinetic parameters and necessary in hepatic DCE-MRI.

## METHODS

This prospective study was approved by the institutional review board. 18 patients with confirmed hepatocellular carcinoma underwent DCE-MRI examination. We applied a 3D non-rigid registration on the dynamic enhanced sequence and pharmacokinetic parameters such as transfer constant [Ktrans], rate constant [kep], and relative extravascular extracellular space [Ve] were obtained with a Reference Model. Firstly, we compared the value of each pixel in the same slice of pre and post-registration images and all the images in dynamic phases were studied. Paired t-test was used to evaluate the discrepant pixels in this two groups. [Ktrans], [kep] and [Ve] value of lesion, liver and sacrospinal muscle were obtained by the mean value of the fixed ROI in the same slice. Then, their values of pre and post registration groups were compared by using relative percent difference (RPD) and The Bland-Altman Plot method. Inter- and intra variations, repeatability and concordance correlation were performed for DCE-MRI quantitative parameters.

## SSQ08-09 Limitations of Gd-EOB-DTPA-enhanced MRI: Can Clinical Parameters Predict Suboptimal Hepatobiliary Phase?

Thursday, Dec. 3 11:50AM - 12:00PM Location: E353A

### Participants

Victoria Chernyak, MD, Bronx, NY (*Presenter*) Nothing to Disclose  
Milana Flusberg, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose  
Mariya Kobi, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Viktoriya Paroder, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose  
Alla M. Rozenblit, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Hepatobiliary phase (HBP) of Gd-EOB-DTPA-enhanced MRI offers additional information not available with extracellular Gd agents. According to Liver Imaging Reporting and Data System (LI-RADS), adequate HBP is essential for reliable characterization of observations relative to the liver parenchyma. LI-RADS deems HBP to be adequate when liver parenchyma is unequivocally hyperintense relative to intrahepatic vessels. Suboptimal HBP would negate the advantage of Gd-EOB-DTPA. Thus, accurate prospective identification of patients who would have suboptimal HBP would be helpful in clinical practice. The goal of this study was to establish cut-off levels for clinical parameters which would predict suboptimal HBP.

## METHOD AND MATERIALS

This retrospective study included patients with chronic liver disease who had hepatocellular carcinoma screening with Gd-EOB-DTPA-enhanced MRI between 1/1/11-3/1/13. For each case HBP was rated as adequate or suboptimal, based on LI-RADS criteria. The following laboratory data obtained within 3 months of MRI date was extracted: total bilirubin (TB), direct bilirubin (DB), serum glutamic oxaloacetic transaminase (SGOT), serum glutamic-pyruvic transaminase (SGPT) and alkaline phosphatase (ALP). Model For End-Stage Liver Disease (MELD) scores were calculated as  $3.78 \times \ln[\text{TB}] + 11.2 \times \ln[\text{INR}] + 9.57 \times \ln[\text{creatinine}] + 6.43$ . Receiver operating curve (ROC) analysis was used to establish cut-off values for predicting suboptimal HBP.

## RESULTS

Of 179 patients, 158 (88.3%) patients (91 [57.6% male] had adequate HBP and 21 (11.7%) patients (13 [61.9%] male) had suboptimal HBP, mean ages 57.7 [ $\pm 9.9$ ] years and 52.7 [ $\pm 14.4$ ] years, respectively ( $p=0.140$ ). Areas under the curve for predicting suboptimal HBP were 0.86 (95%CI 0.78-0.94) for MELD score, 0.87 (95%CI 0.80-0.95) for TB, 0.92 (95%CI 0.86-0.97) for DB, 0.58 (95%CI 0.46 - 0.69) for SGOT, 0.39 (95%CI 0.27 - 0.51) for SGPT. Accuracy, positive likelihood ratios and cut-off values for predicting suboptimal HBP were, respectively: 88.6% and 11.5 for MELD score  $\geq 16.7$ , 90.0% and 35.5 for TB  $\geq 4.3$  mg/dL, 92.9% and 71.0 for DB  $\geq 1.3$  mg/dL.

## CONCLUSION

Values above cut-off levels of MELD score, direct and total bilirubin can predict suboptimal hepatobiliary phase with high accuracy.

## CLINICAL RELEVANCE/APPLICATION

Prospective identification of patients with high likelihood of suboptimal HBP can help avoid administering a more costly agent to patients who would not benefit from its unique properties.

SSQ09

## ISP: Genitourinary (Renal Mass Evaluation)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E353B



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

### Participants

Raghunandan Vikram, MBBS, FRCR, Houston, TX (*Moderator*) Nothing to Disclose

Daniele Marin, MD, Cary, NC (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ09-01 Genitourinary Keynote Speaker: Contemporary Challenges of Imaging Renal Masses

Thursday, Dec. 3 10:30AM - 10:40AM Location: E353B

### Participants

John R. Leyendecker, MD, Dallas, TX (*Presenter*) Nothing to Disclose

#### SSQ09-02 Do Incidental Hyperechoic Renal Lesions Measuring $\leq 1$ cm Warrant Further Imaging? Outcomes of 161 Lesions

Thursday, Dec. 3 10:40AM - 10:50AM Location: E353B

### Participants

Abimbola Ayoola, MD, New York, NY (*Presenter*) Nothing to Disclose

Andrew B. Rosenkrantz, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Ankur Doshi, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Although follow-up CT or MRI has been advised for further evaluation of incidental hyperechoic renal lesions on ultrasound (US), this approach is variably followed in clinical practice given the lack of robust data to guide optimal follow-up recommendations. Thus, the purpose of our study was to determine the outcomes of incidental hyperechoic renal lesions measuring  $\leq 1$ cm based on a large single-center cohort in order to better inform management strategies for such lesions.

### METHOD AND MATERIALS

We retrospectively identified 161 hyperechoic renal lesions on US measuring  $\leq 1$ cm (mean size  $0.7 \pm 0.2$  cm) that had either (a) a follow-up CT or MRI or (b) at least 2 year follow-up by US. Mean patient age was  $63 \pm 13$  years (range 30-88 years). The initial US and follow-up imaging were reviewed to assess for a change in size or definitive lesion characterization.

### RESULTS

Follow-up imaging consisted of US in 23.0% (37/161), CT in 45.3% (73/161) and MRI in 31.7% (51/161). 57.1% (92/161) of lesions were confirmed as angiomyolipomas on CT or MRI. 19.9% (32/161) showed less than 4mm growth on long-term US follow-up (mean  $62 \pm 26$  months, range 24-110 months). 11.8% (19/161) had no correlate on CT or MRI. 6.2% (10/161) were too small to definitively characterize on CT. 3.1% (5/161) were not visualized on follow-up US. CT characterized one lesion (0.6%) as a stone and one lesion (0.6%) as a hyperdense cyst. One lesion (0.6%) on CT was an enhancing solid mass without macroscopic fat, presumed to represent an RCC, although was lost to follow-up. This lesion was not as hyperechoic as the renal sinus fat on the initial US.

### CONCLUSION

The overwhelming majority of hyperechoic renal lesions  $\leq 1$ cm with the classic US appearance of an angiomyolipoma were benign or stable on follow-up imaging. Thus, these lesions may not warrant any further imaging evaluation.

### CLINICAL RELEVANCE/APPLICATION

To our knowledge, we have provided the largest study to date to assess outcomes of small hyperechoic renal lesions on follow-up imaging that support the benignity of this US finding.

#### SSQ09-03 Post-operative Outcomes of Cystic Renal Cell Carcinomas Defined on Pre-operative Computed Tomography: A Retrospective Study in 1315 Patients

Thursday, Dec. 3 10:50AM - 11:00AM Location: E353B

### Participants

Jung Jae Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Chan Kyo Kim, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Byung Kwan Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Byong Chang Jeong, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Seong Il Seo, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Post-operative outcomes of cystic renal cell carcinomas (RCCs) defined on preoperative imaging were not widely investigated and the cut-off of cystic proportion is arbitrary. We aimed to evaluate the post-operative outcomes of cystic RCCs defined on pre-operative computed tomography (CT) and to identify the optimal cut-off of cystic proportion in association with patients' prognosis.

### METHOD AND MATERIALS

Our retrospective study included 1315 consecutive patients who received surgery for single sporadic RCC and had adequate pre-operative CT for analysis. The cystic proportion of RCC was calculated on pre-operative CT by a radiologist. The optimal cut-off of cystic proportion in RCC was explored by locating the minimum P value on log rank test regarding cancer-specific survival. The RCCs were categorized as cystic and non-cystic groups according to (1) conventional cut-off (i.e. proportion of cystic component  $\geq$  75%) and (2) the optimal cut-off, and then cancer-specific and recurrence-free survival rates were compared between the two groups. The clinical, pathologic, and imaging variables were analyzed using the Cox regression analysis to determine the independent predictor of cancer-specific survival.

## RESULTS

Of the 1315 RCCs, 107 (8.1%) were identified as cystic RCCs using the conventional cut-off. During a median follow-up of 4.9 years, patients with cystic RCC revealed neither metastasis nor recurrence after surgery. The cancer-specific and recurrence-free survival rates of cystic RCCs were significantly better than those of non-cystic RCCs (both  $P < 0.001$ ). In association with cancer-specific survival rate, the optimal cut-off of cystic proportion in RCC was 45%, and 197 (15.0%) patients were defined as cystic RCCs accordingly. On multivariate Cox regression analysis, cystic RCC defined by the optimal cut-off (45%) was one of the independent predictors of cancer-specific survival (hazard ratio, 0.34;  $P = 0.03$ ).

## CONCLUSION

Cystic RCCs defined on pre-operative CT are associated with low metastatic potential and favorable outcomes after surgery. Furthermore, the optimal cut-off of cystic proportion in association with cancer-specific survival is 45%.

## CLINICAL RELEVANCE/APPLICATION

Cystic renal cell carcinomas (RCCs) defined by preoperative CT may be managed differently from non-cystic RCCs for selecting optimal treatment methods.

## SSQ09-04 The Radiogenomic Risk Score: Construction of a Prognostic Quantitative, Noninvasive Image-based Molecular Assay for Renal Cell Carcinoma

Thursday, Dec. 3 11:00AM - 11:10AM Location: E353B

### Participants

Neema Jamshidi, MD, PhD, Los Angeles, CA (*Presenter*) Nothing to Disclose  
Eric Jonasch, MD, Houston, TX (*Abstract Co-Author*) Consultant, Pfizer Inc Consultant, Novartis AG Consultant, GlaxoSmithKline plc Consultant, AstraZeneca PLC Research funded, Pfizer Inc Research funded, GlaxoSmithKline plc Research funded, Bristol-Myers Squibb Company Research funded, Novartis AG Research funded, Exelixis, Inc Research funded, Onyx Pharmaceuticals, Inc  
Matthew A. Zapala, MD, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Ronald L. Korn, MD, PhD, Scottsdale, AZ (*Abstract Co-Author*) Chief Medical Officer, Imaging Endpoints; Founder, Imaging Endpoints; Shareholder, Imaging Endpoints  
Lejla Aganovic, MD, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose  
Hongjuan Zhao, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose  
T S. Raviprakash, Umea, Sweden (*Abstract Co-Author*) Nothing to Disclose  
Robert Tibshirani, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose  
Sudeep Banerjee, BA, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
James Brooks, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose  
Borje Ljungberg, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose  
Michael D. Kuo, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Quantitative multi-gene assays are effective clinical decision making tools in oncology, however cost, risks associated with tissue procurement, and difficulty in framing subcellular information within a larger physiological context limits their overall utility. We evaluated the feasibility of reconstructing quantitative non-invasive molecular assays (NIMA) in clear cell renal cell cancer (ccRCC) using data extracted from a single computed tomography (CT) scan.

## METHOD AND MATERIALS

In this IRB approved study, gene expression profile data and contrast enhanced CT scans from 70 ccRCC patients in a training set were initially analyzed. A NIMA for a previously validated ccRCC-specific SPC prognostic gene signature was constructed termed the Radiogenomic Risk Score (RRS), using the microarray data and a 28 trait image array to evaluate each CT scan using multiple regression of gene expression analysis. The predictive power of the RRS NIMA was then prospectively validated in an independent dataset ( $n=77$ ) to confirm its relationship to the SPC gene signature and to quantify individual risk.

## RESULTS

Our quantitative NIMA faithfully represents the tissue-based molecular assay it models. The RRS scaled with the SPC gene signature ( $R=0.57$ ,  $p=6.2e-4$ , classification accuracy 70.1%,  $p<0.001$ ) and predicted disease-specific survival (log rank  $p<0.001$ ). Independent validation confirmed the relationship between the RRS and the SPC gene signature ( $R=0.45$ ,  $p=1.3e-4$ , classification accuracy 68.6%,  $p<0.001$ ) and disease-specific survival (log-rank  $p<0.001$ ) and that it was independent of stage, grade and performance status (multivariate Cox model  $p<0.05$ , log-rank  $p<0.001$ ).

## CONCLUSION

A NIMA for the ccRCC-specific SPC prognostic gene signature that is predictive of disease-specific survival and independent of stage was constructed and validated confirming that quantitative NIMA construction is feasible.

## CLINICAL RELEVANCE/APPLICATION

Non-invasive molecular assays can be constructed that efficiently capture both pre-specified quantitative molecular phenotypes as well as systems-level phenotypes not accessible by genomic-based tests alone, with a range of potential clinical applications including prognostication and patient stratification in human clinical trials.

## SSQ09-05 CAD Derived Absolute Attenuation Discriminates Clear Cell Renal Cell Carcinoma from Benign Mimics and RCC Subtypes at Four-Phase MDCT

Thursday, Dec. 3 11:10AM - 11:20AM Location: E353B

#### Participants

Heidi Coy, Los Angeles, CA (*Presenter*) Nothing to Disclose  
Jonathan R. Young, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
Michael L. Douek, MD, MBA, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
Moe Moe Ko, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
War War Ko, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
Pechin Lo, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
Matthew S. Brown, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
James Sayre, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
Steven S. Raman, MD, Santa Monica, CA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Currently, all solid enhancing non-fatty renal neoplasms are presumed to be malignant. Up to 30% of these lesions are benign, most commonly oncocytoma. Renal Cell Carcinoma (RCC) subtypes are a heterogeneous group treated by surgery, ablation or active surveillance with a prognosis based on histology. The purpose of our study is to determine if peak enhancement derived from volumetric 3D lesion contour and a Computer Aided Diagnostic (CAD) algorithm can discriminate clear cell RCC (ccRCC) from benign RCC mimics and RCC subtypes.

#### METHOD AND MATERIALS

With IRB approval for this HIPAA-compliant retrospective study, our pathology and imaging databases were queried to obtain a cohort of RCC, oncocytoma, and lipid-poor angiomyolipoma (AML) with preoperative multiphasic multidetector CT imaged with a four-phase renal mass protocol (unenhanced, corticomedullary (C), nephrographic (N), and excretory (E)). A whole lesion 3D contour was obtained in all phases with proprietary software. The CAD algorithm determined a 0.5cm diameter region of peak enhancement  $\leq 300$ HU within the 3D lesion contour. All contours were confirmed by a radiologist. T-tests were used to compare peak multiphasic enhancement. P values  $<0.05$  were considered significant.

#### RESULTS

206 patients (65% men, 35% women) with 223 unique renal masses (105 (47%) ccRCC, 41(18%) oncocytoma (O), 18 (8%) chromophobe RCC (chrRCC), 45 (20%) papillary RCC (pRCC), 14 (6%) lipid-poor AML) were analyzed. In the C phase, CAD absolute peak attenuation of the ccRCC (174 HU) was greater than that of O (167 HU,  $p=0.333$ ), chrRCC (136 HU,  $p=0.007$ ), pRCC (85 HU,  $p<0.0001$ ), and lipid-poor AML (144 HU,  $p=0.004$ ). In the N phase, CAD absolute peak attenuation of the ccRCC (144 HU) was greater than that of O (132 HU,  $p=0.015$ ), chrRCC (106 HU,  $p<0.0001$ ), pRCC (103 HU,  $p<0.0001$ ), and lipid-poor AML (115 HU,  $p<0.0001$ ). In the E phase, CAD absolute peak attenuation of the ccRCC (118 HU) was greater than that of O (104 HU,  $p=0.001$ ), chrRCC (86 HU,  $p<0.0001$ ), pRCC (86 HU,  $p<0.0001$ ), and lipid-poor AML (98 HU,  $p=0.001$ ).

#### CONCLUSION

CAD derived absolute attenuation discriminates ccRCC from indolent RCC subtypes and benign RCC mimics at four-phase MDCT

#### CLINICAL RELEVANCE/APPLICATION

CAD enhancement is a robust method to discriminate clear cell RCC from RCC subtypes and benign mimics, enabling clinicians to stratify patients to active surveillance, preoperative biopsy or surgical therapy.

#### SSQ09-06 Prognostic Value of Newly Proposed Response Criteria in Assessing Tumor Response in Advanced Renal Cell Carcinoma

Thursday, Dec. 3 11:20AM - 11:30AM Location: E353B

#### Participants

Hyunseon C. Kang, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose  
Shiva Gupta, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Wei Wei, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Lina Lu, MS, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Marc Matrana, MD, New Orleans, LA (*Abstract Co-Author*) Nothing to Disclose  
Nizar M. Tannir, MD, Houston, TX (*Abstract Co-Author*) Consultant, Onyx Pharmaceuticals, Inc; Consultant, Bayer AG; Consultant, Pfizer Inc; Speakers Bureau, Bayer AG; Speakers Bureau, Onyx Pharmaceuticals, Inc; Speakers Bureau, Pfizer Inc; Research funded, Pfizer Inc; Research funded, Eli Lilly and Company; Research funded, F. Hoffmann-La Roche Ltd; Spouse, Stockholder, Merck & Co, Inc  
Haesun Choi, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Several new solid tumor response criteria have been proposed to overcome the limitations of traditional size based criteria. This study examines the prognostic value of these criteria, and the additive value of clinical risk factors, in patients with advanced renal cell carcinoma (RCC) treated with pazopanib.

#### METHOD AND MATERIALS

Fifty-seven patients with metastatic RCC, who were treated with pazopanib after progression with other targeted therapies, were studied retrospectively. Two sets of CTs (pre- and 1-3.5 months post-treatment) were reviewed by 2 abdominal radiologists. Tumor response on the post-therapy scan was evaluated with RECIST, Choi, modified Choi, MASS, the 10% threshold criteria, as well as a consensus subjective reader assessment, simulating radiologists' clinical interpretation. In addition to these criteria, combined criteria incorporating MSKCC risk factors + imaging criteria were used to define response groups. Response evaluations were correlated with overall survival (OS) and progression-free survival (PFS) using the log-rank test. Only patients with partial response (PR) or stable disease (SD) were included in the analysis of PFS.

#### RESULTS

The 6 patients with progressive disease (PD) by RECIST, and the 22 patients with PD by the subjective reader assessment, had

significantly worse OS compared to patients with SD or PR. There was no significant difference in OS between responders and nonresponders by Choi, modified Choi, or MASS criteria. When MSKCC risk factors were combined with imaging criteria, the combined criteria defined groups of patients with significantly worse OS. Patients with PR by modified Choi criteria showed significantly longer PFS compared to those with SD ( $p=0.033$ ). PR and SD groups defined by other criteria did not show a significant difference in PFS. The MSKCC risk factors did not improve the prognostic ability of imaging-based criteria to predict patients with longer PFS.

## CONCLUSION

Patients with PD by either RECIST or the subjective reader assessment had significantly worse survival compared to SD or PR groups. The addition of MSKCC risk factors significantly increased the predictive value of all criteria for OS. This effect was dominated by the MSKCC criteria, which were strongly correlated with survival.

## CLINICAL RELEVANCE/APPLICATION

In the salvage therapy setting, the addition of clinical risk factors improves the predictive value of imaging-based tumor response criteria.

### SSQ09-07 Diagnostic Accuracy of Unenhanced MRI for Suspicious Malignant Renal Lesions Inend Stage Renal Failure Patients with Acquired Cystic Disease

Thursday, Dec. 3 11:30AM - 11:40AM Location: E353B

#### Participants

Rafel Tappouni, MBCh, FRCPC, Winston-Salem, NC (*Presenter*) Nothing to Disclose  
David D. Childs, MD, Clemmons, NC (*Abstract Co-Author*) Research Grant, Endocare, Inc  
Shadi Qasem, Winston-Salem, NC (*Abstract Co-Author*) Nothing to Disclose  
Keyanoosh Hosseinzadeh, MD, Winston-Salem, NC (*Abstract Co-Author*) Consultant, Bayer AG

## PURPOSE

To determine sensitivity, specificity and accuracy of unenhanced MRI in detecting malignant lesions in end stage renal failure patients with acquired renal cystic disease (ARCD). To assess added value of diffusion weighted imaging (DWI) in characterizing lesions. To identify MRI features associated with malignant lesions.

## METHOD AND MATERIALS

Unenhanced renal MRIs of 55 patients with ARCD were retrospectively reviewed in consensus by two blinded radiologists. Lesions less than 1 cm were excluded. Lesions were scored based on size, T1 and T2 signal, homogeneity, hemosiderin, and DWI on a 5 point scale: 1 as definitely benign, 2 as probably benign, 3 as indeterminate, 4 as probably malignant and 5 as definitely malignant. Preliminary scoring was performed without DWI and repeated with DWI. Scores 1-2 were grouped as benign and 3-5 as malignant. Sensitivity, specificity and accuracy of diagnosis was calculated by comparing to nephrectomy samples performed within 6 months of the MRI in 40 patients and five year imaging and clinical follow up in 15 patients. Stability over a 5 year period was deemed benign. Chi square test assessed the imaging features. Scores were renumbered to a 3-level confidence score: 0, indeterminate; 1, probably benign and malignant; 2, definitely benign and malignant, and a paired t-test was performed to compare confidence levels.

## RESULTS

There were 26 cysts (8 nephrectomy, 18 imaging follow up) and 34 solid lesions including 1 urothelial carcinoma, 2 oncocytomas and 31 renal cell carcinomas. Lesion size ranged from 1-17cm. MRI features suggestive of malignancy included T1 iso or hyperintensity ( $p=0.0003$ ), T1 heterogeneity ( $p=0.0037$ ), T2 heterogeneity ( $p=0.0092$ ), and presence of hemosiderin ( $p=0.0034$ ). The sensitivity, specificity and accuracy for preliminary diagnosis versus final diagnosis using DWI were 82, 69, 77 and 82, 73, 78 respectively. The area under the receiver operator curve for the diagnosis with DWI was 0.8512. The addition of DWI resulted in an increase of the confidence score ( $p=0.001$ ).

## CONCLUSION

Unenhanced renal MRI is an accurate modality in characterizing lesions in ARCD. DWI can increase the confidence for the diagnosis of malignant renal lesions. T1 iso and hyperintensity, T1 and T2 signal heterogeneity and the presence of hemosiderin are associated with malignant lesions.

## CLINICAL RELEVANCE/APPLICATION

Unenhanced renal MRI is accurate in the detection of malignant lesions in ARCD.

### SSQ09-08 Impact of Imaging and Histological Findings on the Prognosis of xp-11 Translocation Renal Cell Cancer

Thursday, Dec. 3 11:40AM - 11:50AM Location: E353B

#### Participants

Pauley T. Gasparis, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose  
Kumaresan Sandrasegaran, MD, Carmel, IN (*Abstract Co-Author*) Nothing to Disclose  
Kevin A. Parikh, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose  
Kunal B. Gala, MBBS, MD, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose  
Clinton D. Bahler, MD, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose  
Chandru P. Sundaram, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Xp11 translocation renal cell cancer (Xp11RCC) is an uncommon RCC (<1%) in the general population but accounts for 30% of RCC presenting under the age of 18 years. We wanted to identify imaging features at presentation and histological findings of the resected tumor that predicted overall survival (OS), progression-free survival (PFS), and the occurrence of local and distant metastases.

## METHOD AND MATERIALS

Retrospective review of pathology database from Jan 2001 to Mar 2015 revealed 22 cases with Xp11RCC. Imaging findings at presentation were available in 18 of these cases. Detailed analysis of imaging findings for tumor size, calyceal invasion, necrosis, hemorrhage, exophytic growth, presence of local or distant metastases at presentation were recorded. Pathological findings including T-staging, margin positivity, Fuhrman grade and immunostain positivity were recorded. Clinical and imaging databases were used to determine OS, and PFS. Multivariate regression analysis and Kaplan-Meier survival statistics were performed.

## RESULTS

Mean age at surgery was 40.2 (range 10-83) years. 15 of 22 patients were over 18 years. 1-, 2- and 3-year survivals were 88%, 79%, and 73% respectively. On CT / MRI, the majority of tumors enhanced to a lesser degree than adjacent cortex (13/18), were heterogeneous (11/18) and exophytic (14/18). Necrosis was seen in 5 tumors and correlated with larger tumor size ( $p < 0.01$ ), while calyceal invasion (seen in 6 tumors) did not ( $p = 0.07$ ). On multivariate logistic regression analysis, PFS correlated only with Fuhrman grade ( $p = 0.04$ ) and calyceal invasion ( $p = 0.05$ ) and recurrence of metastatic disease correlated only with initial tumor size ( $p = 0.05$ ). Age and gender at presentation, tumor heterogeneity, and necrosis did not correlate with prognosis. On analysis of overall survival, tumors  $> 5$  cm had a substantially worse outcome than those  $< 5$  cm (log rank test, Chi Square 6.73,  $p < 0.01$ ).

## CONCLUSION

For staging scans of Xp11RCC, radiologists should assess tumor size and calyceal invasion as these have the most impact on survival. Unlike previous studies, we did not find younger patients to have better clinical outcomes.

## CLINICAL RELEVANCE/APPLICATION

Calyceal invasion by tumor and tumor size  $> 5$ cm predict adverse outcome in Xp11 RCC.

## Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Kumaresan Sandrasegaran, MD - 2013 Honored Educator

Kumaresan Sandrasegaran, MD - 2014 Honored Educator

## SSQ09-09 How Does the Surrounding Background Fat Affect Enhancement of Exophytic Renal Lesions? A Phantom Study

Thursday, Dec. 3 11:50AM - 12:00PM Location: E353B

### Participants

Adeel R. Seyal, MD, Chicago, IL (*Presenter*) Grant, Siemens AG

Atila Arslanoglu, MD, Chicago, IL (*Abstract Co-Author*) Grant, Siemens AG

Faezeh Sodagari, MD, Chicago, IL (*Abstract Co-Author*) Grant, Siemens AG

Yuri Velichko, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

Paul Nikolaidis, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

Vahid Yaghmai, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate the effect of surrounding tissue composition on renal lesion enhancement at multidetector computed tomography.

## METHOD AND MATERIALS

Two phantoms (A and B) simulating renal lesions were constructed with 15 test tubes (1.5 cm in diameter) each. For phantom A, the tubes were embedded in fat (-90 HU); and for phantom B, the tubes were embedded in agar gel (neutral medium; 7.3HU). The tubes were filled with a serial dilution of iodinated contrast [iohexol (300mg/mL)]. Both phantoms were scanned twice using a 64-slice scanner at 120kVp and constant 150mAs. Attenuation was calculated by a centrally placed region-of-interest within each test tube and the surrounding medium and averaged over five slices for each acquisition. Mean of measurements from both acquisitions were used for analysis. The amount of contrast needed to attain an enhancement of 10HU and 20HU were determined. Regression, paired t and Wilcoxon signed rank tests were used for analysis.

## RESULTS

Iodine concentration of 0.285 and 0.675 mg/mL resulted in enhancement of 10 HU and 20 HU, respectively, for a lesion surrounded by fat and 7.3 HU and 16.62 HU when lesion surrounded by neutral medium. At any given iodine concentration, the contrast enhancement was significantly greater for a lesion surrounded by fat when compared with the lesion surrounded by neutral medium ( $P < 0.0001$ ).

## CONCLUSION

A renal mass surrounded by fat tends to show greater enhancement compared with one surrounded by a neutral medium.

## CLINICAL RELEVANCE/APPLICATION

Thresholds for enhancement may be different for renal lesions surrounded by fat when compared to intraparenchymal or partially exophytic lesions.

## Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Vahid Yaghmai, MD - 2012 Honored Educator  
Vahid Yaghmai, MD - 2015 Honored Educator

SSQ06

## Gastrointestinal (Quantitative Imaging)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E350

**GI** **BQ** **CT** **MI** **MR**

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

**FDA** Discussions may include off-label uses.

### Participants

Claude B. Sirlin, MD, San Diego, CA (*Moderator*) Research Grant, General Electric Company; Speakers Bureau, Bayer AG; Consultant, Bayer AG ; ;  
Alexander R. Guimaraes, MD, PhD, Portland, OR (*Moderator*) Speakers Bureau, Siemens AG; Expert Witness, Rice, Dolan, Kershaw  
Andrew D. Smith, MD, PhD, Jackson, MS (*Moderator*) Research Grant, Pfizer Inc; President, Radiostics LLC; President, Liver Nodularity LLC; President, Color Enhanced Detection LLC; Pending patent, Liver Nodularity LLC; Pending patent, Color Enhanced Detection LLC;

### Sub-Events

#### SSQ06-01 3D Vibe-Dixon MR Sequence in Hepatic Fat Quantification: Inter-reader Reproducibility and Correlation to MRS Results in a Liver Donor Cohort

Thursday, Dec. 3 10:30AM - 10:40AM Location: E350

### Participants

Chiara Pozzessere, MD, Siena, Italy (*Presenter*) Nothing to Disclose  
Xiangyu Zhu, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Celia P. Corona-Villalobos, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Lorenzo Righi, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose  
Sandra L. Castanos Gutierrez, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Fatemeh Sobhani, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Neda Rastegar, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Li Pan, Baltimore, MD (*Abstract Co-Author*) Employee, Siemens AG  
Ihab R. Kamel, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Liver steatosis is the most common liver disease in Western Countries and it may progress to steatohepatitis and cirrhosis. Magnetic Resonance Spectroscopy (MRS) has been shown to strongly correlate with histology in fat quantification. However, MRS has some limitations such as breathing artifact and difficulties in avoiding vessels or bile ducts within the voxel. 3D VIBE-Dixon is a MR sequence which can quantify fat content. The aim of this study was to compare fat quantification of liver using 3D VIBE-DIXON to that using MRS.

### METHOD AND MATERIALS

IRB approved this prospective, HIPAA compliant study. Thirty potential liver donors (14 males, 12 females; mean age 38 yo) underwent liver MR, including single voxel MRS, within the right (RL) and left lobe (LL) and axial 3D VIBE-Dixon. Liver biopsy was performed in 8 patients. Fat percentage (FP) was generated by MRS. Two readers blinded to MRS results independently quantified the FP on 3D VIBE-Dixon by drawing a ROI in both lobes in the same locations of the MRS voxels. Lin's concordance correlation was used to assess concordance between MRS and 3D VIBE-Dixon, for the two readers. Intraclass correlation coefficient was used to compare 3D VIBE-Dixon to histology. Inter-observer agreement was calculated. A  $p \leq 0.05$  was considered statistically significant.

### RESULTS

In the RL, mean FP was 5.8% by MRS, and 4.8% and 4.8% by 3D VIBE-Dixon for readers 1 and 2, respectively, with a strong concordance between the two technique ( $\rho = 0.78$  and  $0.76$  for reader 1 and 2, respectively,  $p < 0.001$ ). In the LL, mean FP was 5.2% by MRS, and 4.2% and 4% by 3D VIBE DIXON for readers 1 and 2, respectively, with medium concordance between the two sequences ( $\rho = 0.44$  and  $0.38$  for readers 1 and 2, respectively). Inter-observer agreement was excellent in both RL and LL ( $\rho = 0.96$  and  $0.92$ , respectively,  $p < 0.001$ ). In the 8 patients who underwent biopsy FP by 3D VIBE-DIXON highly correlated to histological results ( $ICC = 0.85$ ).

### CONCLUSION

In this prospective study, fat quantification using 3D VIBE-DIXON was highly reproducible, with strong correlation to MRS in the RL. Correlation was moderate in the LL, probably due to artifacts on MRS.

### CLINICAL RELEVANCE/APPLICATION

3D VIBE-DIXON is a highly reproducible MR sequence, which may allow non-invasive fat quantification in the liver. Further studies with larger cohort and pathology comparison are required.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Ihab R. Kamel, MD, PhD - 2015 Honored Educator

#### SSQ06-02 Inter-site Reproducibility of 2D MR Elastography Analysis for Hepatic Stiffness in a Cohort of Obese



## Adults

Thursday, Dec. 3 10:40AM - 10:50AM Location: E350

### Participants

William Haufe, San Diego, CA (*Presenter*) Nothing to Disclose  
Curtis N. Wiens, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Catherine A. Hooker, BS, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose  
Tanya Wolfson, MS, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose  
Alan B. McMillan, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Paul Manning, MSc, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose  
Kang Wang, PhD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose  
Scott B. Reeder, MD, PhD, Madison, WI (*Abstract Co-Author*) Institutional research support, General Electric Company Institutional research support, Bracco Group  
Michael S. Middleton, MD, PhD, San Diego, CA (*Abstract Co-Author*) Consultant, Allergan, Inc Institutional research contract, Bayer AG Institutional research contract, sanofi-aventis Group Institutional research contract, Isis Pharmaceuticals, Inc Institutional research contract, Johnson & Johnson Institutional research contract, Synageva BioPharma Corporation Institutional research contract, Takeda Pharmaceutical Company Limited Stockholder, General Electric Company Stockholder, Pfizer Inc Institutional research contract, Pfizer Inc  
Claude B. Sirlin, MD, San Diego, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Speakers Bureau, Bayer AG; Consultant, Bayer AG ; ;

### PURPOSE

To assess the inter-site reproducibility of 2D magnetic resonance elastography (MRE) analysis for hepatic stiffness in obese adults

### METHOD AND MATERIALS

In this HIPAA compliant, IRB approved study, obese (BMI  $\geq 30$  kg/m<sup>2</sup>) adults underwent 2D MRE on a 1.5T or 3.0T GE scanner at one of two sites. A passive driver produced 60 Hz acoustic shear waves through the liver, and MRE-generated wave images, magnitude images, and stiffness maps (elastograms) were transferred offline for manual analysis. Analysts at each of the two separate sites evaluated all exams from both sites. Analysts drew regions of interest (ROIs) on the elastograms in areas of the liver where parallel wave propagation was observed on the corresponding wave image. From these ROIs, stiffness values were recorded. Weighted average was applied to obtain a single per-liver stiffness value. Bland-Altman plot and intraclass correlation coefficient (ICC) were used to assess inter-site reproducibility. Paired t-test was used to examine systematic shifts.

### RESULTS

87 adults (74 female, 13 male) underwent MRE. The mean ( $\pm$  standard deviation) age and BMI were 48.3 ( $\pm$  12.5) years and 42.6 ( $\pm$  5.8) kg/m<sup>2</sup> respectively. Fourteen scans were considered unanalyzable by at least one of the two sites due to low signal-to-noise or poor wave propagation. Hence, data from 73 subjects were used in reproducibility analyses. ICC for the two sites was .833 [0.724, 0.898]. Mean ( $\pm$  standard deviation) stiffness values for site A and site B were 2.90 ( $\pm$  1.06 kPa) and 3.13 ( $\pm$ 1.15 kPa) respectively. A small, clinically non-meaningful, but statistically significant bias was observed (mean difference .23 kPa, paired t-test  $p=0.0016$ ).

### CONCLUSION

MRE analysis for hepatic stiffness from independent analysts at two separate sites had high reproducibility. There was a small systematic bias observed between the two participating study sites, which was not clinically meaningful in the context of staging liver fibrosis.

### CLINICAL RELEVANCE/APPLICATION

In order for 2D MRE to be clinically useful in the staging of hepatic fibrosis, liver stiffness results must be analyst and site independent. Studies such as this will help demonstrate the reproducibility of MRE stiffness values.

## SSQ06-03 <sup>1</sup>H-Magnetic Resonance Spectroscopy is Superior to Controlled Attenuation Parameter (CAP) in Assessing Liver Fat Content in Human Non-alcoholic Fatty Liver Disease (NAFLD)

Thursday, Dec. 3 10:50AM - 11:00AM Location: E350

### Awards

#### Trainee Research Prize - Resident

### Participants

Jurgen H. Runge, MD, PhD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose  
Loek P. Smits, MD, MSc, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Joanne Verheij, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Aart N. Nederveen, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
U Beuers, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Jaap Stoker, MD, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Research Consultant, Robarts Clinical Trials

### PURPOSE

Non-alcoholic fatty liver disease (NAFLD) is an increasingly recognized health problem worldwide. Liver biopsy is the diagnostic standard, but liver fat content is preferably assessed noninvasively and quantitatively. Recently, the Controlled Attenuation Parameter (CAP) technique was introduced on the FibroScan®, a transient elastography device with FDA approval since 2013. Only limited data are available regarding CAP's accuracy compared to established quantitative measures. Therefore, we prospectively compared CAP and <sup>1</sup>H-Magnetic Resonance Spectroscopy (<sup>1</sup>H-MRS) derived fat fractions (FF) against liver biopsy in a cohort of patients with NAFLD.

### METHOD AND MATERIALS

Forty NAFLD patients (M/F: 29/11) with median (IQR) age of 52.6 (48.5-57.3) and BMI of 27.1 (25.4-33.1) were included in this IRB-approved study. Same-day 3T MRI and CAP measurement were performed by a single examiner within 27 (17-50) days of liver

biopsy, assessed by a single pathologist. <sup>1</sup>H-MRS derived FF and CAP values were compared between Brunt steatosis grades S0-S3 using Kruskal-Wallis and Mann-Whitney-U tests. Correlations were assessed with Spearman's. Diagnostic accuracies of CAP and FF to identify  $\geq$ S1 on biopsy were compared with ROC analyses.

## RESULTS

Median FF differed ( $p < 0.0001$ ) between all histological steatosis grades at 1.0%(0.7-1.4), 6.1%(3.9-8.8), 17.4%(11.3-21.1) and 26.3%(25.0-30.1). Median CAP only differed between grades S0 and S2 ( $p = 0.025$ ) and S1 and S2 ( $p = 0.006$ ) at 260 dB/m (221-320), 281 dB/m (249-331), 330 dB/m (305-378) and 348 dB/m (321-353). FF ( $r = 0.90$ ; 95%-CI:0.81-0.95) correlated better ( $P = 0.0002$ ) with steatosis grades than CAP ( $r = 0.53$ ; 95%-CI:0.25-0.73). The area under the ROC curve (AUROC) to identify  $\geq$ S1 was higher ( $P = 0.04$ ) for <sup>1</sup>H-MRS at 0.98 (95%-CI:0.93-1.0) than for CAP at 0.76 (95%-CI:0.56-0.95). Optimal cut-off values of 4.1% and 261 dB/m resulted in sensitivity/specificity/positive/negative predictive values of 89%/100%/100%/56% for <sup>1</sup>H-MRS and 89%/60%/94%/43% for CAP.

## CONCLUSION

<sup>1</sup>H-MRS derived FF differed between all four steatosis grades on biopsy, while CAP did not. Better correlation with histological features and superior AUROC to identify steatosis stage  $\geq$ S1 reaffirm <sup>1</sup>H-MRS as preferred method for noninvasive liver fat content assessment.

## CLINICAL RELEVANCE/APPLICATION

<sup>1</sup>H-MRS derived liver fat fractions show better diagnostic accuracy than CAP values for accurate noninvasive liver fat content assessment.

### SSQ06-04 Assessment of Liver and Pancreas Iron Overload with a 3T MRI Multiecho GRE Sequence in Diffuse Liver Disorders: Correlation with Serum Ferritin and Liver Biopsy

Thursday, Dec. 3 11:00AM - 11:10AM Location: E350

#### Participants

Manuela Franca, MD, Porto, Portugal (*Presenter*) Nothing to Disclose  
Angel Alberich-Bayarri, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose  
Luis Marti-Bonmati, MD, PhD, Godella, Spain (*Abstract Co-Author*) Nothing to Disclose  
Graca Porto, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose  
Helena Pessegueiro Miranda, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose  
Joao A. Oliveira, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose  
Francisca E. Costa, MD, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose  
Jose Ramon Vizcaino Vazquez, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Iron overload is associated with hereditary hemochromatosis, chronic transfusions, hemolytic conditions and diffuse liver diseases such as chronic hepatitis C, alcoholic liver disease and NAFLD. Pancreatic iron can be also found in some of these conditions. Our objective was to assess R2\* values of the liver and pancreas in patients with chronic diffuse liver diseases, comparing the R2\* values with serum ferritin levels and liver biopsy.

## METHOD AND MATERIALS

A total of 99 consecutive patients with chronic diffuse liver disorders who underwent liver biopsy and abdominal MR examination were included. The 3T MR examination included a single breath-hold multiecho GRE sequence with 12 echoes. Iron related-R2\* quantification was performed with a dedicated software selecting a ROI within the biopsied liver segment and also in the pancreas (head, body and tail). Liver biopsy was used as gold standard for liver iron deposits grading (0-4).

## CONCLUSION

There is an excellent relationship between liver R2\*-iron quantification against liver biopsy and serum ferritin, in different chronic liver disorders. Pancreas R2\* is significantly correlated with serum ferritin, liver R2\* and histologic iron grading.

## CLINICAL RELEVANCE/APPLICATION

In patients with diffuse chronic liver disorders, pancreas R2\* correlate with liver R2\* and biopsy-proved liver iron overload.

### SSQ06-05 Liver Volume-assisted Estimation of Liver Function Based on Gd-EOB-DTPA-enhanced MR-Relaxometry

Thursday, Dec. 3 11:10AM - 11:20AM Location: E350

#### Awards

##### RSNA Country Presents Travel Award

#### Participants

Michael Haimerl, Regensburg, Germany (*Presenter*) Nothing to Disclose  
Niklas Verloh, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Claudia Fellner, MD, PhD, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Marcel D. Nickel, Erlangen, Germany (*Abstract Co-Author*) Employee, Siemens AG  
Christian R. Stroszczyński, MD, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Philipp Wiggermann, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To determine whether liver function as determined by indocyanine green (ICG) clearance can be estimated quantitatively from gadoteric acid (Gd-EOB-DTPA)-enhanced magnetic resonance (MR)-Relaxometry and to estimate the impact of liver volumes.

## METHOD AND MATERIALS

132 patients underwent an ICG clearance test and Gd-EOB-DTPA-enhanced MRI, including MR-Relaxometry at 3 Tesla. A transverse

3D VIBE sequence with an inline T1 calculation was acquired prior to and 20 minutes post-Gd-EOB-DTPA administration. Volumetric analysis of respective livers was performed on Aquarius iNtuition Viewer (TeraRecon Inc.). The reduction rate of T1 relaxation time (rrT1) between pre- and post-contrast images and the liver volume-assisted index of T1 reduction rate (LVrrT1) were evaluated. The plasma disappearance rate of ICG (ICG-PDR) was correlated with the liver volume (LV), rrT1 and LVrrT1, providing an MRI-based estimated ICG-PDR value (ICG-PDRest).

## RESULTS

Regression model showed a significant log-linear correlation of ICG-PDR with LV ( $r = 0.31$ ;  $p = 0.001$ ), T1post ( $r = 0.62$ ;  $p < 0.001$ ) and rrT1 ( $r = 0.85$ ;  $p < 0.001$ ). Assessment of LV and consecutive evaluation of multiple linear regression model revealed a stronger log-linear correlation of ICG-PDR with LVrrT1 ( $r = 0.91$ ;  $p < 0.001$ ), allowing for the calculation of ICG-PDRest.

## CONCLUSION

Liver function as determined using ICG-PDR can be estimated quantitatively from Gd-EOB-DTPA-enhanced MR-Relaxometry. Volume-assisted MR-Relaxometry has a stronger correlation with liver function than does MR-Relaxometry.

## CLINICAL RELEVANCE/APPLICATION

Global and regional liver function may be visualized by Gd-EOB-DTPA-enhanced MRI, which might be of importance for planning liver resections.

## SSQ06-06 Liver Volume Predicts the Clinical Outcome of Patients with Decompensated Alcoholic Steatohepatitis

Thursday, Dec. 3 11:20AM - 11:30AM Location: E350

### Participants

Maxime Ronot, MD, Clichy, France (*Abstract Co-Author*) Nothing to Disclose  
Romain Breguet, MD, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Catrina Hansen, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Christoph D. Becker, MD, Thonex, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Laurent Spahr, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Sylvain Terraz, MD, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Matthieu Lagadec, MD, Clichy, France (*Presenter*) Nothing to Disclose

## PURPOSE

To evaluate the prognostic value of abdominal multidetector computed tomography (MDCT) in patients with decompensated alcoholic steatohepatitis (ASH).

## METHOD AND MATERIALS

This ancillary study was based on the analysis of data collected during a randomized trial on ASH treatment. Response to treatment was defined as the improvement of the baseline MELD score  $\geq 3$  points at 3 months. All patients underwent contrast-enhanced MDCT of the abdomen. The following parameters were measured: 1/ liver (DL) and spleen (DS) density on unenhanced images, and DL/DS ratio, 2/ liver volume-to-body weight ratio (VLBW), 3/ subcutaneous fat (FSC), visceral fat (FV) and muscular (M) surfaces at the level of L3-L4. Responders and non-responders were compared with uni-, multivariate and ROC analyses. Results were compared with a validation cohort of patients, clinically and biologically similar to the study cohort.

## RESULTS

Fifty-eight patients (34 males; mean age, 56 years) were analyzed, including 34 (59%) responders. Baseline mean MELD and ABIC scores were 19 (13-28) and 8.3 (6.5-10.3). On multivariate analysis, VLBW (OR=3.73; 95%CI, 1.64-8.46;  $p=0.002$ ) and FSC (OR=1.01; 95%CI, 1.00-1.02;  $p=0.022$ ) were associated with response to treatment, with AUROC curves of  $0.78 \pm 0.06$  ( $p < 0.001$ ) and  $0.66 \pm 0.07$  ( $p=0.043$ ), respectively. BMI, baseline MELD and ABIC scores, gender, DL/DS, FV and M were not different between the two groups.  $VLBW \geq 2.4\%$  predicted response with 88% and 63% sensitivity and specificity. In the validation cohort ( $n=24$ , 75% responders), the same cut-off value predicted response with 83% and 67% sensitivity and specificity.

## CONCLUSION

In patients suffering from decompensated ASH, the liver volume appears to be a major positive prognostic factor. This simple morphometric parameter may be added to the initial evaluation of the liver disease to improve patient management.

## CLINICAL RELEVANCE/APPLICATION

The liver volume-to-body weight ratio appears to be a major prognostic factor in patients with ASH. This morphometric parameter could be added to the initial workup of patients, to better predict the response to treatment and improve the management.

## SSQ06-07 MRI Based Quantification of Hepatic Uptake and Excretion of Gadoteric Acid: Preliminary Results

Thursday, Dec. 3 11:30AM - 11:40AM Location: E350

### Participants

Daniel Truhn, MD, Cologne, Germany (*Presenter*) Nothing to Disclose  
Alexander Cirtsis, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Nienke L. Hansen, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Alexandra Barabasch, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Burkhard Maedler, Bonn, Germany (*Abstract Co-Author*) Researcher, Koninklijke Philips NV  
Christiane K. Kuhl, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose  
Nils A. Kraemer, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Recent research in liver MRI has shown that quantification of hepatic uptake of gadoteric acid is a promising method for determination of local liver function and correlates well with established clinical measures of liver function. The aim of this study was to evaluate a method for combined measurement of hepatic uptake and excretion.

## METHOD AND MATERIALS

After intravenous administration of gadoteric acid, signal enhancement of liver tissue in 14 healthy patients was measured over the time course of 30 minutes. First, the data was assessed using previously published methods that do not consider excretion. Then, a dual inlet two compartment model was appended by a parameter describing the excretion of contrast medium into the bile. A least squares fit was performed to extract the following parameters: extra- and intracellular volume fraction, uptake and excretion rates, arterial and portal venous flow fractions. Results for the models without and with consideration of excretion were subsequently compared.

## RESULTS

The dual inlet two compartment model provided the best agreement between modeled and measured signal values when compared to previously published methods that do not consider excretion of contrast agent. The mean value for the uptake rate in healthy liver tissue was  $4.76 \pm 0.54$  /100/min. Excretion half-time was  $21.9 \pm 2.4$  min. Inter-patient variance was significantly greater when conventional models (uptake only) models were applied. We found a significant deviation between modeled and measured signal values with an uptake rate of  $3.56 \pm 1.34$  /100/min. Excretion rates could only be obtained with the dual inlet two compartment model.

## CONCLUSION

The model not considering the excretion was only valid in the first 5 minutes of hepatic signal enhancement and failed over the course of 30 minutes. Accurate modeling of gadoteric acid induced hepatic enhancement over a longer time course requires a dual inlet two compartment model. Including this parameter into models of liver tissue might lead to a more precise correlation between hepatic function and MRI.

## CLINICAL RELEVANCE/APPLICATION

When aiming to measure hepatic function using MRI not only the hepatic uptake, but also the excretion should be taken into account to get better correlations between MRI and liver function.

## SSQ06-08 The Attenuation Distribution Across the Long Axis (ADLA): Evaluation of Predictive Performance in a Large Clinical Trial

Thursday, Dec. 3 11:40AM - 11:50AM Location: E350

### Awards

#### Trainee Research Prize - Medical Student

#### Participants

Nikita Lakomkin, Nashville, TN (*Presenter*) Nothing to Disclose  
Allison Hainline, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose  
Hakmook Kang, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose  
M. S. Hutson, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose  
Carlos L. Arteaga, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose  
Richard G. Abramson, MD, Nashville, TN (*Abstract Co-Author*) Consultant, ICON plc;

## PURPOSE

Novel methods of image feature analysis may be a useful adjunct to standard methods of cancer treatment response assessment. The attenuation distribution across the long axis (ADLA) is a simple, easily extractable measure of lesion heterogeneity; in a recent preliminary study, ADLA measurements predicted overall survival (OS) better than RECIST 1.1. The purpose of this study was to evaluate the ability of the ADLA method to predict OS in a larger clinical trial.

## METHOD AND MATERIALS

Under a data sharing agreement from Genentech (San Francisco, CA) and an IRB waiver from our institution, we obtained de-identified imaging and clinical data from RIBBON-1, a multi-site phase 3 trial of bevacizumab (Avastin) in metastatic breast cancer. We analyzed all RIBBON-1 patients treated with Avastin who had at least 1 liver metastasis measuring  $\geq 15$  mm on baseline contrast-enhanced CT. For each patient at every time point, up to 2 target liver lesions were evaluated using both RECIST 1.1 criteria and ADLA. The ADLA was obtained as the standard deviation of the post-contrast CT attenuation values in the portal venous phase across a long-axis diameter function. To define a treatment response using ADLA, Brier scores were computed to establish the optimal percent decrease for separating patients with longer OS. Using Kaplan-Meier survival analysis, the log-rank test was then used to evaluate the ability of a treatment response by ADLA measurements to predict OS. The ADLA method was then compared to RECIST 1.1 using a bootstrapping technique that generated 95% confidence intervals on the Brier scores for both approaches.

## RESULTS

165 patients met inclusion criteria. Median OS was 461 days (range 60-916). The ADLA method discriminated patients with longer OS at an optimal threshold of a 21.5% decrease from baseline. At this threshold, a treatment response by the ADLA method successfully separated patients with longer OS ( $p < 0.001$ ). Furthermore, a treatment response by ADLA was superior to a response by RECIST 1.1 for discriminating patients with longer OS (95% confidence interval for the Brier score difference: [0.070-0.52]). Kaplan-Meier survival curves are shown below.

## CONCLUSION

In retrospective data analysis from a large clinical trial, the ADLA method was superior to RECIST 1.1 for predicting overall survival.

## CLINICAL RELEVANCE/APPLICATION

The ADLA measurement is an easily extractable parameter that may be useful for assessing cancer treatment response.

## SSQ06-09 Differences of Target Lesion Selection Drives Variability of Response Assessment According to RECIST 1.1

Thursday, Dec. 3 11:50AM - 12:00PM Location: E350

## **Awards**

### **RSNA Country Presents Travel Award**

#### Participants

Yunus Alparslan, Aachen, Germany (*Presenter*) Nothing to Disclose

Jonas Schmoë, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

Hanna Witte, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

Annika Keulers, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

Christiane K. Kuhl, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose

Sebastian Keil, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

## **PURPOSE**

To conduct a prospective systematic analysis of factors contributing to variability of response classification in RECIST1.1 beyond factors related to disease measurement, i.e. variability that persists even if dedicated software for response assessment is used.

## **METHOD AND MATERIALS**

63 patients ( $60 \pm 9$  years) underwent a total 132 contrast-enhanced CT studies for initial staging or follow-up after systemic chemotherapy. A target or non-target lesion satisfying RECIST1.1 criteria could be identified in 52/63 patients (82.5%) and 113/132 (85.6%) of (re-)staging CT studies. Data were independently interpreted by three radiologists with > 4 years of experience who used specialized software (MintMedical) for standardized response assessment. Response was classified in complete or partial response (CR, PR), or stable or progressive disease (SD, PD), and stratified as progressive (PD) vs. non-progressive (CR, PR, SD).

## **RESULTS**

Overall, readers agreed in terms of response classification in 58.4% of studies (66/113) and disagreed in 41.6% (47/113). In 50/113 studies, readers had chosen the same, and in 63/113 studies, readers had chosen different target lesions. Selection of the same target lesions was associated with an 88% rate (44/50) of agreement; selection of different target lesions was associated with a 74.6% rate (47/63) of disagreement. After dichotomizing response classes according to their therapeutic implication in PD vs. non-PD RECIST1.1 response classes, disagreement was observed in 17/113 staging examinations (15%). In 13 of these 17 patients (76.5%), readers had chosen different target lesions.

## **CONCLUSION**

The basic assumption of standardized response assessment is that different readers should yield the same response classification for a given patient. In fact, however, different readers disagree in almost half of patient cases, and in 15%, they disagree even with regards to the basic distinction between PD vs. non-PD. Major source of variability appears to be the fact that different readers may choose different target lesions. The resulting variability between readers will not be compensated for by software tools for automated response assessment.

## **CLINICAL RELEVANCE/APPLICATION**

Even with standardized RECIST readings and use of dedicated automated software, different radiologists will yield different results with regards to response classification, even with regards to broadly different categories (PD vs. non-PD).

SSQ03

## Cardiac (General Topics II)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S504CD

CA CT MR

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

FDA Discussions may include off-label uses.

### Participants

Andre J. Duerinckx, MD, PhD, Washington, DC (*Moderator*) Nothing to Disclose  
James C. Carr, MD, Chicago, IL (*Moderator*) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

### Sub-Events

#### SSQ03-02 The Impact of Iterative Reconstruction on Detectability and Quantification of Calcifications in CT Coronary Calcium Scoring: Individual Lesion-by-lesion Comparison

Thursday, Dec. 3 10:40AM - 10:50AM Location: S504CD

### Participants

Jelmer M. Wolterink, MSc, Utrecht, Netherlands (*Abstract Co-Author*) Research Grant, Pie Medical Imaging BV  
Tim Leiner, MD, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Speakers Bureau, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, Bracco Group  
Martin J. Willemink, MD, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Max A. Viergever, Utrecht, Netherlands (*Abstract Co-Author*) Research Grant, Pie Medical Imaging BV;  
Ivana Isgum, PhD, Utrecht, Netherlands (*Presenter*) Research Grant, Pie Medical Imaging BV; Research Grant, 3mensio Medical Imaging BV;

### PURPOSE

The amount of coronary artery calcium (CAC) as quantified in cardiac CT is a strong and independent predictor of cardiovascular events. Cardiac CT can be reconstructed using iterative reconstruction (IR), which reduces objective image noise compared with filtered back projection (FBP). We have investigated the impact of IR on the detectability and quantification of CAC lesions.

### METHOD AND MATERIALS

The study included 101 consecutive patients who underwent non-contrast-enhanced ECG-triggered cardiac CT for CAC scoring (256-detector row CT, 120 kVp, 55 mAs). Five series with 3 mm slice thickness were reconstructed for each CT: one with FBP and four with increasing IR levels (iDose4 L1, L3, L5, L7). CAC lesions ( $\geq 130$  HU) in the FBP series were identified by an expert and matching lesions in the IR series were identified at corresponding locations. Calcium volume (in mm<sup>3</sup>) and calcium mass (in mg) of matching lesions in different series were compared. The Friedman test (significance level  $P < 0.05$ ) was used to analyze overall differences among series. The Wilcoxon signed-rank test with Bonferroni correction (significance level  $P < 0.007$ ) was used to analyze pairwise differences between series.

### RESULTS

The FBP series contained 416 CAC lesions with median (interquartile range) volume 16.0 (5.6-41.1) mm<sup>3</sup> and mass 3.3 (0.9-10.6) mg. Out of these, 14 (3%), 25 (6%), 35 (8%) and 42 (10%) lesions with volume/mass below 2.4 mm<sup>3</sup>/0.4 mg, 4.7 mm<sup>3</sup>/0.8 mg, 4.7 mm<sup>3</sup>/0.8 mg, and 6.3 mm<sup>3</sup>/0.9 mg were identified in the FBP series but not in the L1, L3, L5 and L7 series, respectively. For lesions identified in all series, calcium volume and mass differed significantly among series ( $P < 0.05$ ). A significant reduction in calcium volume and mass was present between the FBP series and each IR series ( $P < 0.007$ ), as well as between series with increasing IR levels ( $P < 0.007$ ).

### CONCLUSION

IR causes significant reductions in volume and mass of CAC lesions. Small low-density lesions are increasingly likely to be missed in CAC scoring when higher IR levels are used.

### CLINICAL RELEVANCE/APPLICATION

CAC scoring in IR CT may underestimate cardiovascular risk, especially in patients with small low-density CAC lesions.

#### SSQ03-03 In vivo Coronary Artery Plaque Assessment with Computed Tomography Angiography – Is There an Impact of Iterative Reconstruction on Plaque Volume and Attenuation Metrics?

Thursday, Dec. 3 10:50AM - 11:00AM Location: S504CD

### Participants

Zhongyi Chen, Montreal, QC (*Presenter*) Nothing to Disclose  
Irina Boldeanu, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Simon Nepveu, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Madeleine Durand, MD, MSc, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Anne S. Chin, MD, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose  
Carl Chartrand-Lefebvre, MD, Montreal, QC (*Abstract Co-Author*) Equipment support, Koninklijke Philips NV; Equipment support, Bayer AG;  
Claude Kauffmann, PhD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Gilles P. Soulez, MD, Montreal, QC (*Abstract Co-Author*) 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

## PURPOSE

Coronary computed tomography (CT) angiography allows to evaluate coronary plaque characteristics, such as low attenuation (lipid-filled) component, and can impact on plaque vulnerability assessment and patient prognostication. The objective of the study is to determine the effect of iterative reconstruction (IR) on coronary plaque volume and composition assessment.

## METHOD AND MATERIALS

Approval was obtained from Institutional Review Board and written consent from all subjects. Asymptomatic patients without known coronary artery disease were prospectively enrolled for low-dose 256-slice CT. Images were reconstructed with both filtered back projection (FBP) and hybrid IR algorithm (iDose4, Philips) levels 1, 3, 5 and 7 (noise reduction 11, 23, 37, 56%, respectively). Noise, signal-to-noise (SNR) and contrast-to-noise ratio (CNR) in aorta and coronary arteries were measured. Coronary plaques were assessed using a Hounsfield unit (HU)-mapping method, according to five intervals: <51 HU, 51-100 HU, 101-150 HU, 151-350 HU and >350 HU. For each plaque, total absolute volume, absolute and percentage HU-interval volumes were calculated. ANOVA repeated-measure analyses were used.

## RESULTS

Fifty-three patients (mean age 53.6 yo) were included. In comparison to FBP, IR reduced image noise ad 53%, increased SNR ad 111% and CNR ad 99% ( $p < 0.0005$ , respectively). Plaque characterization performed in 35 patients for a total of 96 plaques showed a mean total plaque volume of  $99.1 \pm 116.3$  to  $100.2 \pm 117.6$  mm<sup>3</sup> across all IR levels and FBP ( $p = 0.628$ ). In per-HU-interval analysis within the 101-150 HU interval, absolute plaque volume showed slight differences between FBP ( $11.7 \pm 12.6$  mm<sup>3</sup>) and IR level 7 ( $10.8 \pm 11.7$  mm<sup>3</sup>) ( $p = 0.03$ ) and between IR levels 5 ( $11.4 \pm 12.8$  mm<sup>3</sup>) and 7 ( $p = 0.03$ ). For percentage volume, a slight difference was observed within the 101-150 HU interval between FBP ( $12.6 \pm 5.1\%$ ) and IR level 7 ( $11.9 \pm 4.8\%$ ) ( $p = 0.04$ ). Absolute and percentage plaque volume was similar across other IR levels and HU-intervals.

## CONCLUSION

Total coronary plaque volume measured at all IR noise reduction levels was similar to FBP. Plaque volumetric assessment in low HU-interval domains was slightly affected at high IR levels.

## CLINICAL RELEVANCE/APPLICATION

Total coronary plaque volume with IR is similar to FBP. However low attenuation plaque volume, a marker for plaque vulnerability, is slightly modified at high IR levels.

## SSQ03-04 Myocardial Involvement in Anderson Fabry Disease Can Be Assessed and Quantified Using Magnetic Resonance Post-contrast T1 Mapping

Thursday, Dec. 3 11:00AM - 11:10AM Location: S504CD

### Participants

Julian Donhauser, MD, Wurzburg, Germany (*Presenter*) Nothing to Disclose  
Gordian G. Schmid, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Andreas M. Weng, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Herbert Koestler, PhD, Wurzburg, Germany (*Abstract Co-Author*) Research support, Siemens AG  
Dietbert Hahn, MD, Kuernach, Germany (*Abstract Co-Author*) Nothing to Disclose  
Thorsten A. Bley, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Christian O. Ritter, MD, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Anderson Fabry disease (AFD) is a rare intracellular lipid disorder which can lead to LV-hypertrophy and myocardial fibrosis. We propose that besides late gadolinium enhancement (LGE), T1-mapping is a promising diagnostic tool in AFD allowing an early detection of cardiac involvement. Furthermore we suggest, that MRI findings correlate with serum biomarkers indicating myocardial damage.

## METHOD AND MATERIALS

46 patients (20 LGE positive [group 1], 26 LGE negative [group 2]) with manifest AFD were examined. In addition, 28 healthy subjects were examined as a reference [group 3]. T1-mapping was performed with a modified Look-Locker IR sequence (MOLLI) at a 3T MR-scanner after i.v. gadolinium administration. Results were derived from 8 slices moving continuously from basal to apical. Separate ROIs were drawn in the anterior, inferior, septal, lateral and inferolateral wall. In addition, an average value from the entire myocardial ring (SAX) was acquired for each slice. Absolute T1 values were compared in between those three groups. In addition, T1 values of the patient groups were correlated with the biochemical markers NT-proBNP, Troponin T and lyso-Gb3.

## RESULTS

Final results show visible changes in the T1-maps wherever fibrosis in the LGE imaging was observed. Absolute T1 values for several ROIs were significantly lower in group 1 compared to group 2 and 3 (inferolateral wall:  $p < 0.01$ ; others:  $p < 0.05$ ), even in areas where no fibrosis was detected by LGE imaging (anterior and septal wall). T1 mapping was not able to distinguish between LGE-negative patients and healthy controls. NT-proBNP and Troponin T levels were significantly higher in group 1 compared to group 2 ( $p < 0.01$ ). Lyso-Gb3 serum levels were elevated in 100% [group 1] and 86% [group 2] of patients, there was no significant difference in lyso-Gb3 values in between those groups.

## CONCLUSION

Our data suggest that T1-mapping is a sensitive tool to detect early replacement fibrosis in AFD, and might be more sensitive than visual LGE analysis in the detection of regional myocardial involvement. Elevated levels of Troponin T and NT-proBNP indicate myocardial involvement and correlate with findings in cardiac MRI.

## CLINICAL RELEVANCE/APPLICATION

T1 mapping may be useful to identify AFD patients with myocardial involvement. This method could be especially useful in follow up as it offers the possibility to absolutely quantify the extent of fibrosis and monitor therapy effects.

## SSQ03-05 Image Quality of Cardiac Magnetic Resonance Imaging in Patients with an ICD System Designed for the MRI Environment

Thursday, Dec. 3 11:10AM - 11:20AM Location: S504CD

### Participants

Torsten Sommer, MD, Bonn, Germany (*Presenter*) Research Consultant, Medtronic, Inc  
Michael R. Gold, MD, PhD, Charleston, SC (*Abstract Co-Author*) Research Consultant, Medtronic, Inc  
Ahmed Al Fagih, MD, Riyadh, Saudi Arabia (*Abstract Co-Author*) Nothing to Disclose  
Sung W. Lee, MD, Washington, DC (*Abstract Co-Author*) Nothing to Disclose  
Michael Peterson, MD, St. Paul, MN (*Abstract Co-Author*) Nothing to Disclose  
Allen Ciuffo, MD, Norfolk, VA (*Abstract Co-Author*) Research Consultant, Medtronic, Inc  
Yan Zhang, MS, Mounds View, MN (*Abstract Co-Author*) Nothing to Disclose  
Nina Kristiansen, Maastricht, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Emanuel Kanal, MD, Pittsburgh, PA (*Abstract Co-Author*) Consultant, Boston Scientific Corporation; Consultant, Medtronic, Inc;  
Consultant, St. Jude Medical, Inc; Consultant, Bayer AG; Investigator, Bracco Group; Royalties, Guerbet SA;  
Juerg Schwitter, MD, Lausanne, Switzerland (*Abstract Co-Author*) Research Consultant, Medtronic, Inc

### PURPOSE

To evaluate the image quality performance of various cardiac MR pulse sequences in a clinical trial of patients (pts) implanted with an MR-conditional ICD system.

### METHOD AND MATERIALS

The Evera MRI randomized clinical trial enrolled 275 pts from 42 centers world-wide. 263 pts were implanted with an Evera MRI single or dual chamber ICD and randomized to the MRI group (n=175) or control group (n=88). Per protocol 156 MRI pts underwent an MRI examination at 9-12 weeks post implant. Steady-state free precession (SSFP) and fast gradient echo (FGE) sequences were acquired each in short-axis (SA) and horizontal long axis (HLA) views to optimize image quality. Acquisitions with correct slice orientations on both, SA and HLA of at least one sequence type were graded for image quality using a 7-point scale (grade 1: excellent image quality, grade 6-7: non-diagnostic quality). Grades were analyzed by Generalized Estimating Equation. Presence and size of ICD- and lead-related artifacts were evaluated.

### RESULTS

Complete cardiac MR data were obtained in 104 pts for SSFP covering the left ventricle (LV), in 89 pts for FGE on LV, in 103 pts for SSFP on the right ventricle (RV), and in 76 for FGE on the RV. The corresponding proportions of diagnostic image quality (grades 1-5) were 53% (55/104), 74% (66/89), 69% (71/103) and 84% (64/76), respectively. In 107 pts at least one evaluable sequence was obtained. The odds of having a better image quality (i.e. a lower grade) was greater for RV vs LV (OR: 1.8, 95% CI: 1.5-2.2,  $p < 0.0001$ , regardless of sequence type) and greater for FGE vs SSFP (OR: 3.4, 95% CI: 2.5-4.7,  $p < 0.0001$ , regardless of ventricle type). Compared to SSFP, the ICD-related artifacts on FGE were smaller ( $141.0 \pm 65$  vs  $75.3 \pm 56.7$  mm, respectively,  $p < 0.0001$ ) irrespective of imaging plane. Lead artifacts were much smaller than ICD artifacts ( $p < 0.0001$ ); differences in lead artifact diameters between SSFP ( $8.3 \pm 3.3$  mm) and FGE ( $10.2 \pm 3.2$  mm) were small, but statistically significant ( $p < 0.0001$ ).

### CONCLUSION

FGE produces better quality and smaller artifacts for cardiac MRI than SSFP in pts with an MRI ICD system. Diagnostic image quality is obtainable with FGE in 74% and 84% of studies of the LV and RV, respectively.

### CLINICAL RELEVANCE/APPLICATION

Diagnostic image quality of cardiac MRI cine scans in patients with an ICD system designed for the MRI environment can be obtained in the majority of cases using fast gradient echo sequences.

## SSQ03-06 Advanced Modelled Iterative Reconstruction (ADMIRE) in Coronary Computed Tomography Angiography (CCTA): Effect on Image Quality

Thursday, Dec. 3 11:20AM - 11:30AM Location: S504CD

### Participants

Christina Kolb, Dresden, Germany (*Presenter*) Nothing to Disclose  
Ivan Platzek, MD, Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose  
Uwe Speiser, 01307 Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose  
Dirk Danowski, 01307 Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose  
Thomas Brauer, MD, Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose  
Danilo Seppelt, Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose  
Eric Langer, Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose  
Christoph Radosa, 01307 Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose  
Manuela Campan, 01307 Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose  
Michael Laniado, MD, Dresden, Germany (*Abstract Co-Author*) Reviewer, Johnson & Johnson  
Ruth Strasser, 01307 Dresden, Germany (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

The purpose is to assess the effect of ADMIRE on image quality in CCTA.

### METHOD AND MATERIALS

30 patients who underwent CCTA on a third generation dual source CT scanner were included in this retrospective study. CCTA datasets were reconstructed using filtered back projection (FBP) and increasing strength levels of ADMIRE 1-5. The signal-to-noise ratio (SNR) in the ascending aorta and the proximal part of both coronary arteries were determined for each data set. Furthermore, a qualitative evaluation of image quality was undertaken independently by two readers using a five-point scale. Repeated measures analysis of variance was used to compare SNR for different modes of image reconstruction. The Friedman test was applied to compare image quality scores.



## RESULTS

CCTA was performed successfully in all patients. In the ascending aorta, mean SNR ( $\pm$  SD) was 11.5 ( $\pm$  4.3) in FBP, 12.9 ( $\pm$  4.9) in ADMIRE 1, 14.5 ( $\pm$  5.7) in ADMIRE 2, 16.3 ( $\pm$  6.3) in ADMIRE 3, 19.4 ( $\pm$  7.7) in ADMIRE 4 and 23.6 ( $\pm$  10.6) in ADMIRE 5. In the proximal right coronary artery, mean SNR ( $\pm$  SD) was 13.2 ( $\pm$  6.1) in FBP, 15.4 ( $\pm$  7.0) in ADMIRE 1, 17.5 ( $\pm$  7.9) in ADMIRE 2, 21.3 ( $\pm$  10.5) in ADMIRE 3, 24.6 ( $\pm$  12.3) in ADMIRE 4 and 30.1 ( $\pm$  16.4) in ADMIRE 5. In the left main coronary artery, mean SNR was 11.7 ( $\pm$  4.7) in FBP, 13.5 ( $\pm$  5.8) in ADMIRE 1, 15.3 ( $\pm$  6.4) in ADMIRE 2, 17.5 ( $\pm$  7.1) in ADMIRE 3, 20.7 ( $\pm$  8.2) in ADMIRE 4 and 25.1 ( $\pm$  10.2) in ADMIRE 5. In the ascending aorta, the proximal RCA and the left main, higher strength levels of iterative reconstruction showed significantly higher SNR in comparison to all lower strength levels and FBP ( $p < 0.001$  in all cases). Image quality scores improved significantly from FBP to ADMIRE 4 ( $p < 0.05$ ) with each successive level of iterative reconstruction strength. However, image quality scores did not differ significantly between ADMIRE 4 and 5 datasets ( $p > 0.05$ ).

## CONCLUSION

ADMIRE significantly improves image quality in CCTA, both in regard to SNR and qualitative scores. However, as there was no significant difference between ADMIRE 4 and 5 for subjective image quality, this high strength levels can be used interchangeably, depending on the preference of the respective radiologist. As a consequence of our results, further dose reduction seems to be feasible in CCTA.

## CLINICAL RELEVANCE/APPLICATION

As ADMIRE improves image quality compared to FBP, the use of ADMIRE has the potential for further reduction of CCTA radiation exposure while retaining adequate image quality.

### SSQ03-07 Qualitative and Quantitative Evaluation of Myocardial Alterations by Grating-Based Phase-Contrast Computed Tomography

Thursday, Dec. 3 11:30AM - 11:40AM Location: S504CD

#### Participants

Susan Notohamprodo, MD, Munich, Germany (*Presenter*) Nothing to Disclose  
Nicole Webber, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose  
Lorenz Bimbacher, Garching, Germany (*Abstract Co-Author*) Nothing to Disclose  
Marian Willner, Munchen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Julia Herzen, Garching, Germany (*Abstract Co-Author*) Nothing to Disclose  
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Mathias Marschner, Garching, Germany (*Abstract Co-Author*) Nothing to Disclose  
Doris Mayr, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose  
Harald Bartsch, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose  
Franz Pfeiffer, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose  
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Tobias Saam, MD, Munich, Germany (*Abstract Co-Author*) Research Grant, Diamed Medizintechnik GmbH; Research Grant, Pfizer Inc

#### PURPOSE

Grating-based phase-contrast computed tomography (gb-PCCT) relies on X-ray refraction rather than absorption to generate high-contrast images in biological soft tissue. The aim was to evaluate the potential of gb-PCCT for the depiction of structural changes in different cardiomyopathies.

#### METHOD AND MATERIALS

Samples of four human heart specimens from patients with hypertensive, ischemic and dilated cardiomyopathy and cardiac lipomatosis were examined. The gb-PCCT set-up consists of X-ray tube (40 kV, 70 mA), grating-interferometer and detector and allows the calculation of phase- and absorption-contrast data. Normal myocardium, fibrotic scars, diffuse interstitial fibrosis and fatty tissue were evaluated by visual inspection and quantitative absorption- and phase-contrast Hounsfield units (HUabs and HUP, respectively). Histopathology served as standard of reference. Measurements of diagnostic accuracy including sensitivity and specificity were calculated. Systematic differences in HUabs and HUP were assessed by ANOVA.

#### RESULTS

A total of 35 corresponding gb-PCCT and histopathology cross-sections were available. Normal myocardium was found in 35 (100%), fibrotic scars in 6 (17.1%), interstitial fibrosis in 7 (20%) and fatty tissue in 25 (71.4%) cross-sections and were accurately detected by gb-PCCT (sensitivity and specificity >90%). Mean HUP for normal myocardium, fibrotic scars, interstitial fibrosis and fatty tissue were 52.5, 86.6, 62.4 and -38.6. Corresponding mean HUabs were 54.1, 69.7, 62.3 and -258.9, respectively. We observed an overlap in HUabs for normal myocardium and interstitial fibrosis but not for HUP. Contrast-to-noise ratio was significantly higher in phase- than in absorption-contrast for myocardium/fat (32.7 vs. 7.2;  $p < 0.01$ ) and for myocardium/fibrotic scar (3.6 vs. 0.2;  $p < 0.01$ ).

#### CONCLUSION

Given its superior soft tissue contrast, gb-PCCT is able to depict structural changes in different cardiomyopathies, which can currently not be obtained by X-ray absorption based imaging methods.

#### CLINICAL RELEVANCE/APPLICATION

If current technical limitations can be overcome, gb-PCCT may evolve as a powerful tool for the anatomical assessment of cardiomyopathy.

### SSQ03-08 Diagnostic Performance of Stress Perfusion Cardiovascular Magnetic Resonance with 1.5-T and 3-T Scanners in Comparison with Invasive Coronary Angiography

Thursday, Dec. 3 11:40AM - 11:50AM Location: S504CD

#### Participants

Sung Min Ko, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

## PURPOSE

3-T cardiovascular magnetic resonance (CMR) perfusion has shown higher diagnostic performance for detection of significant coronary artery disease (CAD) in comparison to 1.5-T perfusion. However, more data are needed for proving superiority of 3-T to 1.5-T perfusion. This study was aimed to compare the diagnostic performances of CMR perfusion at 1.5-T and 3-T in patients with suspected or known CAD.

## METHOD AND MATERIALS

We prospectively enrolled 308 patients (221 men, 69.5±6.4 years) with suspected or known CAD. All patients were scanned at 1.5-T or 3-T including adenosine stress and rest perfusion and delayed enhancement imaging. Invasive coronary angiography (ICA) served as the reference method. Perfusion defects were interpreted visually by 2 radiologists with consensus. A coronary vessel was considered to be significantly stenosed if there was at least 1 segment with ≥ 70% lumen reduction.

## RESULTS

The prevalence of CAD was 56%. Of 308 patients, 162 patients were scanned at 1.5-T and 146 patients at 3-T. Significant coronary stenoses and old myocardial infarction (MI) were found in 101 (62%) and 66 (41%) patients at 1.5-T and 70 (48%) and 27 (18%) patients at 3-T. Diagnostic accuracy, sensitivity, specificity, positive predictive value and negative predictive value for detection of significant coronary stenoses were 77%, 71%, 81%, 70%, and 82% at 1.5-T and 83%, 64%, 91%, 75%, and 86% at 3.0T. The diagnostic performance of 3-T perfusion imaging was not significantly greater than that of 1.5-T (area under receiver-operator characteristic [ROC] curve: 0.81 vs 0.76; p=0.159). The combined perfusion and delayed contrast enhancement CMR imaging did not provide incremental diagnostic value over perfusion CMR imaging only at both 1.5-T and 3-T in the diagnosis of CAD. In patients without old MI (n=215), diagnostic accuracy, sensitivity, specificity, positive predictive value and negative predictive value for detection of significant coronary stenoses were 80%, 57%, 84%, 44%, and 90% at 1.5-T and 85%, 60%, 92%, 69%, and 89% at 3-T. The diagnostic performance of 3-T perfusion imaging was significantly greater than that of 1.5-T (area under ROC curve: 0.79 vs 0.67; p=0.026).

## CONCLUSION

3-T CMR perfusion imaging is superior to 1.5-T in detection of significant CAD in patients without old MI.

## CLINICAL RELEVANCE/APPLICATION

3-T CMR perfusion is feasible to detect inducible myocardial ischemia consistent with significant CAD in clinical setting.

## SSQ03-09 Comparison of the Plaque Attenuation Values on Non-enhanced- and Enhanced 320-row Coronary CT Angiographs Using a Subtraction Technique: In vivo Evaluation of the Effect of Intracoronary Attenuation on Coronary Plaque Measurements

Thursday, Dec. 3 11:50AM - 12:00PM Location: S504CD

### Participants

Masafumi Kidoh, Kumamoto, Japan (*Presenter*) Nothing to Disclose  
Daisuke Utsunomiya, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose  
Seitaro Oda, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yoshinori Funama, PhD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose  
Takeshi Nakaura, MD, Amakusa, Japan (*Abstract Co-Author*) Nothing to Disclose  
Tomohiro Namimoto, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hideaki Yuki, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yasuyuki Yamashita, MD, Kumamoto, Japan (*Abstract Co-Author*) Consultant, DAIICHI SANKYO Group  
Kenichiro Hirata, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The characterization of plaques based on their CT number is important for the detection of vulnerable atherosclerotic plaques. An earlier in vitro study showed that intravascular attenuation affected the attenuation of coronary atherosclerotic plaques. We attempted to validate this finding in vivo and here we introduce a new subtraction coronary CT angiography (CCTA) technique to address this issue.

## METHOD AND MATERIALS

This prospective study received institutional review board approval; prior informed consent to participate was obtained from all patients. We performed subtraction CCTA on a 320-detector row CT scanner in 113 patients. Our inclusion criterion was 50-70% stenosis by non-calcified plaques in the proximal coronary artery. Patients with total occlusion and multi-vessel disease were excluded. Consequently, 30 patients (30 plaques) were included in this study. Two CT datasets, one with- and the other without coronary artery enhancement, were obtained to remove calcium from the images. The CT number of the plaque and the adjacent vessel lumen were measured in a circular region of interest (ROI) on curved planar reconstruction (CPR) images. The ROI setting was consistent between the two CT datasets. We performed linear regression analysis of the changes in the CT number ( $\Delta$ HU) for the lumen and the plaque. We also evaluated the relationship between plaque attenuation on non-enhanced coronary artery images and luminal attenuation with and without contrast enhancement.

## RESULTS

The  $\Delta$ HU for the plaque and the lumen showed a strong correlation ( $r=0.62$ ). There was no significant correlation between plaque attenuation on non-enhanced coronary artery images and luminal attenuation with and without contrast enhancement ( $r=0.14$  and  $0.2$ , respectively).

## CONCLUSION

Intravascular attenuation modified the attenuation of coronary atherosclerotic plaques and CT images without coronary artery enhancement in subtraction CCTA may be helpful for the characterization of the plaques.

## CLINICAL RELEVANCE/APPLICATION

Intravascular attenuation modified the attenuation of coronary atherosclerotic plaques in our in vivo validation study.

SSQ18

## Pediatrics (Interventional Radiology)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S102C

**IR** **PD**

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

**FDA** Discussions may include off-label uses.

### Participants

Anne Marie Cahill, MBBCh, Philadelphia, PA (*Moderator*) Nothing to Disclose  
Kamlesh U. Kukreja, MD, Bellaire, TX (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ18-01 Tunneled Central Venous Catheter Placement through the Subclavian Vein Results in Higher Rates of Mechanical Malfunction in Pediatric Patients: One Year Outcome Analysis at a Tertiary-Care Center

Thursday, Dec. 3 10:30AM - 10:40AM Location: S102C

### Participants

Michael P. Yannes, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose  
Orrie N. Close, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Donghoon Shin, MS, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Charles R. Fitz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
John J. Crowley, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Sabri Yilmaz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate pediatric tunneled central venous catheter complication incidence and time to removal with respect to site of insertion.

### METHOD AND MATERIALS

A single-institution, IRB-approved, retrospective review was undertaken of all patients who underwent tunneled central venous catheter placement by either the General Surgery or Interventional Radiology services over a one-year period. Patient electronic medical records were reviewed for technical details, complications, dwell time, indication for placement, and removal. We compared the time-to-removal of tunneled lines for mechanical failure using product limit survival estimates in order to better account for censoring and dwell time of tunneled lines.

### RESULTS

288 central venous lines were placed during a one-year period. Of these, 205 (71%) were placed through the internal jugular vein and 83 (29%) were placed through the subclavian vein. Mechanical malfunction was documented as the indication for removal in 22 of internal jugular lines (11%), versus 19 of subclavian lines (23%) ( $p < .01$ ). Specifically, a higher rate of left-sided subclavian vein lines were removed for mechanical malfunction compared to the right-sided subclavian vein lines (28% vs. 18%, respectively), but time to mechanical failure was not statistically different ( $p = .37$ ).

### CONCLUSION

Placement of tunneled subclavian central venous catheters in the pediatric population results in a higher incidence of mechanical malfunction and a decreased dwell time compared to internal jugular vein placement. Left-sided subclavian catheters tend to have a higher mechanical malfunction rate compared to right-sided subclavian catheters.

### CLINICAL RELEVANCE/APPLICATION

The placement of tunneled subclavian central venous catheters in the pediatric population results in a higher incidence of mechanical malfunction and a decreased dwell time compared to tunneled internal jugular venous central catheters.

#### SSQ18-02 Complication Rates for PICCs Exchanged Over the Wire at a Large Children's Hospital

Thursday, Dec. 3 10:40AM - 10:50AM Location: S102C

### Participants

Nicole Riccioni, Houston, TX (*Presenter*) Nothing to Disclose  
Daniel J. Ashton, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Alberto J. Hernandez, MD, Galveston, TX (*Abstract Co-Author*) Nothing to Disclose  
Christopher I. Cassady, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Sheena Pimpalwar, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Kamlesh U. Kukreja, MD, Bellaire, TX (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Long term venous access is integral to the treatment and therapy of many patients. Complications with line function other than infection can be remedied at times by exchanging the catheter over a wire for a new catheter (rewire). This retrospective study was designed to analyze PICC line complications rates after rewire compared to the overall PICC population.

### METHOD AND MATERIALS

IRB approval allowed retrospective study at a large children's hospital of the electronic medical record and PACS system, which were queried for all PICCs placed from January 2014 through June 2014. Data points collected for each patient included catheter

dwelling time (in days), location of line placement, type of line securement, and complications including infection, malposition, occluded lumen. After compilation, the database was statistically analyzed using Fisher's exact test. Comparisons were made between the total population and those patients that had their PICC exchanged over a wire.

## RESULTS

A total of 665 PICCs were placed in the study period with 73 patients having a rewire of their line. In all patients the complication rate and infection rate were 16% and 6.4%, respectively. In rewire patients the complication rate and infection rate were 48.0% ( $P < 0.0001$ ) and 13.7% (NSS). The most common reasons for rewire were malposition (43.5%) and cracked catheter hub (22.4%). The two most common patient populations requiring rewires were oncology (40.7%) and TPN dependent short gut patients (16.3%). Average catheter dwelling time in all patients was 23.0 days and in rewire patients was 50 days.

## CONCLUSION

The overall complication rate for catheters after rewire was higher than the entire PICC population. The infection rate was not significantly higher, even though the average dwelling time of the catheter was longer in the rewire patients compared to the PICC population.

## CLINICAL RELEVANCE/APPLICATION

For patients that require indefinite venous access such as certain oncology and TPN dependent patients rewire of the malfunctioning line does not incur a higher risk of subsequent infection.

### SSQ18-03 Pediatric Tunneled Central Catheter Placement at A Single Tertiary-Care Center by Interventional Radiology: One Year Outcome Analysis

Thursday, Dec. 3 10:50AM - 11:00AM Location: S102C

#### Participants

Donghoon Shin, MS, Pittsburgh, PA (*Presenter*) Nothing to Disclose  
Michael P. Yannes, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Orrie N. Close, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Fernando A. Escobar, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Charles R. Fitz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
John J. Crowley, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Sabri Yilmaz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The insertion of tunneled central catheters by Pediatric Interventional Radiology services is a daily occurrence. However, little data with respect to placement outcomes of pediatric-tunneled central catheter placement is known. We examine outcomes of all subclavian and internal jugular tunneled central venous catheters placed over a one year period.

## METHOD AND MATERIALS

An IRB-approved, retrospective review was undertaken for all patients who underwent tunneled central venous catheter placement by the Interventional Radiology service over a one year period. Patient electronic medical records were reviewed for technical details, complications, dwelling time, indication for placement, and reason and date of removal. Catheters which were removed due to completion of treatment were censored from the analysis.

## RESULTS

192 (66% of the total hospital placements) tunneled internal jugular and subclavian central venous catheters were placed in 173 patients by the Interventional Radiology service during the study period. 187 (97%) were via the internal jugular vein; 5 (3%) were placed via the subclavian vein. The most frequent indications included chemotherapy (88 placements, 46% of total) and nutrition and frequent blood draws (73 placements, 38%). The median dwelling time was 139.5 days (IQR 43-345); time to removal was significantly shorter ( $p < 0.0005$ ) in the nutrition/frequent blood draw group. Clinical concern for infection was the indication for removal in 31 (16%) of lines, and of these, 15 (8%) had positive blood cultures. Catheters placed for nutrition and frequent blood draws resulted in higher rates of infection ( $N=25$ ) when compared to those being used for chemotherapy ( $N=14$ ). 20 (10%) catheters were removed for mechanical malfunction.

## CONCLUSION

Tunneled central venous catheters placed for nutrition and frequent blood draws resulted in a higher incidence of infection and decreased dwelling time, specifically when compared to catheters placed for chemotherapy. Clinical concern for infection was the most common indication for removal, and mechanical malfunction was the second most common indication for line removal.

## CLINICAL RELEVANCE/APPLICATION

Tunneled central venous catheters placed for nutrition and need for frequent blood draws by the Pediatric Interventional Radiology service resulted in a higher incidence of infection and decreased dwelling time than lines placed for other reasons, most notably administration of chemotherapy.

### SSQ18-04 Complication Rates for PICCs in Patients with AML

Thursday, Dec. 3 11:00AM - 11:10AM Location: S102C

#### Participants

Anoosha Moturu, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Daniel J. Ashton, MD, Houston, TX (*Presenter*) Nothing to Disclose  
Kamlesh U. Kukreja, MD, Bellaire, TX (*Abstract Co-Author*) Nothing to Disclose  
J. Alberto Hernandez, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Christopher I. Cassady, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Treatment of patients with Acute Myeloid Leukemia (AML) requires long-term venous access, one option for which is with a

peripherally inserted central line (PICC). This retrospective study was designed to analyze PICC line infection rates in AML patients compared to the overall PICC and the general oncology populations.

#### **METHOD AND MATERIALS**

IRB approval allowed retrospective study at a large children's hospital of the electronic medical record and PACS system, which were queried for all PICCs placed from January 2014 through June 2014. Data points collected for each patient included catheter dwell time (in days), location of line placement, type of line securement, and complications including infection, malposition, occluded lumen. After compilation, the database was statistically analyzed using Fisher's exact test. Comparisons were made between the total population and those diagnosed with any cancer and patients diagnosed specifically with AML.

#### **RESULTS**

A total of 665 PICCs were placed in the study period, 158 in oncology patients and 23 in AML patients specifically. In all patients the complication rate and infection rate were 16% and 6.4%, respectively. In oncology patients the complication rate and infection rate were 27.2% and 16.5%, respectively ( $P < 0.0001$  for both). In AML patients the complication rate and infection rate were 34.8% (NSS) and 30.4% ( $P < 0.0001$ ), respectively. Average catheter dwell time in all patients was 23.0 days, in oncology patients was 56.5 days, and in AML patients 74.8 days.

#### **CONCLUSION**

Oncology patients and, in particular, AML patients have increased rates of infection compared to the population as a whole. This is in part due to the patients' immunocompromised states and the much longer dwell times of the PICCs used for their treatments. Interventions for decreasing infection rates should be targeted at these high risk populations.

#### **CLINICAL RELEVANCE/APPLICATION**

Acute Myeloid Leukemia patients have an increased risk of infection of PICCs. Identifying populations at high risk allows for targeting changes in practice to reduce infection rates.

#### **SSQ18-05 How Much is Too Much? Radiation Exposure during Percutaneous Gastrojejunostomy Tube Exchanges in Pediatric Patients**

Thursday, Dec. 3 11:10AM - 11:20AM Location: S102C

#### **Participants**

Matthew Hudnall, BA, San Francisco, CA (*Presenter*) Nothing to Disclose  
Kevin S. Koo, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Andrew G. Taylor, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Kanti P. Kolli, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Nicholas Fidelman, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Robert K. Kerlan JR, MD, Kentfield, CA (*Abstract Co-Author*) Nothing to Disclose  
Maureen P. Kohi, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

To evaluate the radiation exposure of pediatric patients during exchange of percutaneous gastrojejunostomy tubes.

#### **METHOD AND MATERIALS**

A retrospective review of consecutive pediatric patients undergoing percutaneous gastrojejunostomy tube exchanges from January 1, 2010 to April 1, 2015 was performed. Fluoroscopy time, cumulative air kerma (mGy) and cumulative dose area product (DAP) (mGycm<sup>2</sup>) values were obtained from procedural reports. Total number of procedures, indications, and time between procedures were also recorded. Patients were subdivided into an increased cumulative procedure group if 3 or more procedures were performed and an increased frequency group if the interval between any 2 procedures was less than 6 months during the study period.

#### **RESULTS**

In the 63-month study period, 130 exchanges of gastrojejunostomy tubes were performed on 48 patients. The median age of all patients was 52.5 months (range 2-206 months). 18 patients underwent a single procedure. Mean cumulative air kerma and DAP were 7.75 mGy (range 2-11.6) and 1353.89 mGycm<sup>2</sup> (range 285-3000) respectively for each procedure. Mean fluoroscopy time was 3.1 minutes (range 1-7). 20 patients were categorized into the increased cumulative procedures group, with a mean of 5 procedures (range 3-8) during the study period. Mean cumulative air kerma and DAP were 53.52 mGy (range 0.4-507) and 4333.45 mGycm<sup>2</sup> (range 102-72,479) respectively for each procedure. Mean fluoroscopy time was 8.6 minutes (range 0.2-40). 25 patients were classified into the increased frequency group, with a mean 4.3 month interval between procedures. Mean cumulative air kerma and DAP were 34.33 mGy (range 0.4-504.8) and 4105.62 mGycm<sup>2</sup> (range 102-72,479) respectively for each procedure. Mean fluoroscopy time was 8.4 minutes (range 0.2-40).

#### **CONCLUSION**

Undergoing percutaneous gastrojejunostomy tube exchanges is necessary in many chronically ill pediatric patients but subjects them to significant radiation exposure at an early age, particularly if repeat procedures are needed. Patients requiring frequent exchanges may benefit from alternative methods to maintain enteral feedings, such as through surgical intervention.

#### **CLINICAL RELEVANCE/APPLICATION**

Radiation exposure in pediatric patients during percutaneous gastrojejunostomy tube exchanges can be significant, and may be underappreciated when considering how to maintain enteral feeding.

#### **SSQ18-06 Incidence and Management of Oesophageal Ruptures Following Fluoroscopic Balloon Dilatation in Children with Benign Strictures**

Thursday, Dec. 3 11:20AM - 11:30AM Location: S102C

#### **Participants**

Jung-Hoon Park, MS, RT, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Ho-Young Song, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Wei-Zhong Zhou, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose  
Jiaywei Tsauo, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Young Chul Cho, BS, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The purpose of this study is to investigate the incidence and management of oesophageal ruptures following fluoroscopic balloon dilatation (FBD) in children with benign oesophageal strictures.

## METHOD AND MATERIALS

Between October 1996 and November 2013, 62 children with benign oesophageal strictures underwent FBDs. Oesophageal rupture was categorized as intramural (type 1), transmural (type 2) or transmural with free leakage (type 3). The possible risk factors for oesophageal ruptures were analyzed.

## RESULTS

One hundred and twenty-nine FBDs were performed in these patients. The oesophageal rupture rate was 17.1% (22/129). The majority (21/22) of ruptures were type 1 and type 2, both were treated conservatively. Only one patient had a type 3 rupture and underwent esophagoesophagostomy. The patient gender, age, and the length and cause of the stricture showed no significant effect on the rupture ( $p > 0.05$ ). However, for the patients  $\leq 2$  years old, the initial balloon with a diameter  $\geq 10$ mm showed a higher oesophageal rupture rate than those  $< 10$ mm during the first session ( $p < 0.05$ ).

## CONCLUSION

Although the oesophageal rupture rate in children was 17.1%, the severe rupture (type 3) rate was 0.8%, which usually requires aggressive treatment. For children  $\leq 2$  years old, the initial balloon diameter should be  $< 10$ mm in the first session for decreasing the risk of oesophageal rupture.

## CLINICAL RELEVANCE/APPLICATION

For children  $\leq 2$  years, the initial balloon diameter should be  $< 10$ mm.

## SSQ18-07 Initial Experience with Pre-procedural MR and Intraprocedural C-arm CT Fusion for Biopsy of MR-positive CT-negative Pelvic Bone Lesions at a Single Pediatric Institution

Thursday, Dec. 3 11:30AM - 11:40AM Location: S102C

### Participants

Sphoorti Shellikeri, Philadelphia, PA (*Presenter*) Research funded, Siemens AG  
Randolph M. Setser, DSc, PhD, Cleveland, OH (*Abstract Co-Author*) Employee, Siemens AG  
Xiaowei Zhu, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Anne Marie Cahill, MBBCh, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Biopsy of bone marrow abnormalities that are CT/fluoroscopically negative but MR-positive often require the physician to review the MRI on a separate console and cross reference anatomic landmarks to the image modality used during biopsy. This pilot study describes our initial experience with pre-procedural MR and intraprocedural C-arm CT fusion for biopsy of MR-positive CT-negative pelvic bone lesions in IR suite at a single pediatric institution.

## METHOD AND MATERIALS

In this IRB-approved prospective study, 5 patients (4F, 1M; mean age 14.8 yrs) with MR-positive CT-negative pelvic bone lesions undergoing bone biopsies were included. A pre-procedural MRI sequence with optimal lesion visualization was fused with an intraprocedural C-arm CT (DynaCT) using 3D/3D fusion software (Siemens Healthcare) and a biopsy path was then planned on the MRI using syngo iGuide. The 3D path was overlaid on the intraprocedural fluoroscopic images. Effective dose was assessed using PCXMC software (v2013, STUK) with an age appropriate model.

## RESULTS

All bone biopsies were performed by the same physician. The mean time interval between the pre-procedural MR and the biopsy was 10 days (range 2-22d). 4/5 biopsies were diagnostic (80% accuracy- 2 neuroblastoma, langerhans cell histiocytosis, chronic osteomyelitis). There were no procedure related complications. The non-diagnostic biopsy was performed in the left iliac bone in a patient with a subtle low standard uptake value MIBG positive lesion concerning for neuroblastoma superimposed on a more diffuse MR-positive abnormality. The MIBG scan was additionally referred to plan the needle path possibly resulting in inaccurate lesion localization. The mean fluoroscopic and procedural times were  $3.8 \pm 2.7$  min and  $87 \pm 22$  min. The mean effective radiation dose was  $6.2 \pm 4$  mSv (1.8, 7.1, 8.4, 11.2, 2.5 mSv).

## CONCLUSION

This pilot experience demonstrates the feasibility of MR-C arm CT fusion for biopsy of CT-negative MR-positive pelvic bone lesions in the IR suite. The advantage of this technique is that it allows the needle path to be planned directly on MRI while visualizing the target lesion. Further validation of this technique will be established with increased patient recruitment.

## CLINICAL RELEVANCE/APPLICATION

3D/3D fusion followed by iGuide technology provides the ability to perform CT-negative MR-positive bone biopsies in the IR suite using real-time fluoroscopic guidance.

## SSQ18-08 Long-term (>5 years) Clinical and Histological Follow-up of Successful Radiological Percutaneous Treatment of Biliary Strictures in Pediatric Liver Transplant Recipients

Thursday, Dec. 3 11:40AM - 11:50AM Location: S102C

### Participants

Roberto Miraglia, MD, Palermo, Italy (*Presenter*) Nothing to Disclose  
Luigi Maruzzelli, MD, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose  
Mario D'Amico, MS, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose  
Silvia Riva, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose  
Marco Spada, MD, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose  
Angelo Luca, MD, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose

## **PURPOSE**

Good results are reported for percutaneous treatment (PT) of biliary strictures (BS) in children underwent liver transplant (LT) however, in majority of the published studies on this topic, only a short or mid-term follow-up is available. Aim of this study is to retrospectively evaluate long-term follow-up (>5 years) of successful PT of BS in children underwent LT.

## **METHOD AND MATERIALS**

From 1/2004 to 12/2014, 70 pediatric LT recipients underwent PT of BS in our hospital. 35 out of 70 had a follow-up longer than 5 years and represent our study cohort. Mean recipient age at the time of PT was 5 y/o (range, 8 months - 16 y/o). Anastomotic BS was present in 29 patients, anastomotic and intrahepatic BS were present in 6 patients.

## **RESULTS**

In all patients percutaneous stenting and bilioplasty were successfully performed without major complications. Mean number of balloon dilatation performed was 4 (range, 3-8). Mean duration of catheter placement was 5 months (range 2-10). In 10 out of 35 patients (28%) two courses of PT were necessary; the mean time to recurrence was 19 months (range, 3-61 months). One patient had redo LT 91 months after PT for chronic rejection; one patient is with a biliary catheter in place for portal biliopathy secondary to portal cavernoma and is on waiting list for redo LT. 33 patients are symptom-free with respect to BS at a mean follow-up of 95 months (range, 65-131 months). 32 out of 35 patients underwent liver biopsy at a mean follow-up of 5 years (range 3-8 years) after last PT with evidence of mild cholestasis N=7 (22%), moderate/severe cholestasis N=3 (10%), chronic rejection N= 2 (6%), no cholestasis N=20 (62%).

## **CONCLUSION**

Clinical and histological good response can be maintained in a long-term follow-up in more than half of pediatric LT recipients with BS treated with percutaneous approach.

## **CLINICAL RELEVANCE/APPLICATION**

Percutaneous treatment of BS is a safe and effective procedure in pediatric LT recipients, however more large-scale research and longer follow up are needed.

## **SSQ18-09 Comparison of Safety and Efficiency of Image Guided Enema Reduction Techniques for Pediatric Intussusception: A Review of the Literature**

Thursday, Dec. 3 11:50AM - 12:00PM Location: S102C

### **Participants**

Renny Chew, MBBS, Footscray, Australia (*Presenter*) Nothing to Disclose  
Stacy K. Goergen, MBBS, Clayton, Australia (*Abstract Co-Author*) Nothing to Disclose  
Michael R. Ditchfield, MBBS, Parkville, Australia (*Abstract Co-Author*) Nothing to Disclose

## **PURPOSE**

There is variable practice regarding the technique of image guided enema reduction of paediatric intussusception (IGPIR) and use of procedural sedation/general anaesthesia (GA). Our objectives are to review the literature regarding efficacy and safety of hydrostatic versus pneumatic reduction performed under fluoroscopic versus ultrasound control. A secondary outcome is to determine whether procedural sedation/general anaesthesia (GA) influences outcomes.

## **METHOD AND MATERIALS**

Articles were identified by searching OVID Medline on 21/2/14 using keywords "intussusception", "child" and "treatment" and by scanning retrieved articles reference lists. Letters, editorials, and narrative reviews were excluded. Systematic reviews (SR) were appraised with the PRISMA critical appraisal tool. Primary studies underwent a critical appraisal designed by reviewers and successes and perforations per attempt were calculated for each study and an average calculated for each technique.

## **RESULTS**

One SR and 87 primary studies were included (5 comparative studies, 82 studies on single techniques and no RCT). Of the 88 studies, 17 reported consistent use of sedation and 4 the use of GA. The SR included 20 studies comparing the success rate of hydrostatic versus pneumatic reduction (including 2 RCTs) and supports pneumatic over hydrostatic reduction. Hydrostatic reduction under ultrasound control appears to have similar efficacy and safety to pneumatic reduction under fluoroscopic control. Efficacy and perforation rates for the studies on single techniques are listed in the figure provided.

## **CONCLUSION**

Limited RCT data is available to support one IGPIR method over another. Pneumatic reduction would be preferable over hydrostatic reduction under fluoroscopic guidance based on greater efficacy and comparably low perforation rate. Hydrostatic reduction under ultrasound control should be considered an alternative, as it affords no ionised radiation exposure. Sedation does not appear to alter likelihood of reduction or procedural morbidity. Data relating to GA are too limited to allow practice recommendations with regard to its effect on efficacy and safety.

## **CLINICAL RELEVANCE/APPLICATION**

Practice variation of image guided enema reduction techniques for paediatric intussusception may impact on perforation rates, ionising radiation exposure, requirement for surgery, and adverse patient experience.

SSQ15

## ISP: Nuclear Medicine (Emerging Methods and Techniques)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S505AB



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

**FDA** Discussions may include off-label uses.

### Participants

Charles M. Intenzo, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose  
Don C. Yoo, MD, Providence, RI (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ15-01 Nuclear Medicine Keynote Speaker: Advances in Clinical Optical Imaging

Thursday, Dec. 3 10:30AM - 10:50AM Location: S505AB

### Participants

Jan Grimm, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

#### SSQ15-03 Focal 18F-FDG Uptake in PET-MRI Indicates Activated Facet Arthrosis and Guides Facet Block Therapy: A Prospective Pilot Study in 11 Patients Suffering from Neck Pain

Thursday, Dec. 3 10:50AM - 11:00AM Location: S505AB

### Participants

Lino Sawicki, MD, Dusseldorf, Germany (*Presenter*) Nothing to Disclose  
Benedikt M. Schaarschmidt, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose  
Philipp Heusch, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose  
Christian Buchbender, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose  
Frank Floeth, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose  
Gerald Antoch, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate the potential role of 18F-FDG-PET/MRI in detecting activated facet arthrosis and its impact on therapy.

### METHOD AND MATERIALS

Eleven consecutive patients with musculoskeletal neck pain (mean pain on visual analogue scale (VAS) > 7, median duration 9 months, no radiculopathy or myelopathy) were prospectively enrolled in this study. Mean and maximum standard uptake values (SUV<sub>mean</sub>/max) were measured one hour after injection of 18F-FDG in each facet joint and patient. On STIR-images bone signal intensity (SI) ratios between each facet joint and Th1 vertebral body (reference site) were measured and calculated. Post-hoc Mann-Whitney-U-Test (MWU) was performed to identify differences in SUV<sub>mean</sub>, SUV<sub>max</sub> and bone SI ratio on STIR images between normal, arthrotic and activated arthrotic facet joints. Focal tracer uptake in a facet joint served as target for CT guided infiltration using local anesthetics and corticosteroids. In patients without focal uptake, facet blocks were performed to the segment of maximum cervical osteoarthritis. Neck pain was measured before and after the infiltration on VAS.

### RESULTS

18F-FDG-PET/MRI detected focal tracer uptake along the facet joint capsule in 6 of 11 patients (average SUV<sub>max</sub>: 3,5 +/- 0,9; average SUV<sub>mean</sub>: 2.5 +/- 0.9) with good match to the patients' pain localization. Posthoc MWU revealed significantly higher SUV<sub>max</sub>, SUV<sub>mean</sub> and bone SI Ratio on STIR images in activated facet arthrosis than in normal or arthrotic facet joints (p<0.001). Correlation was strong between bone SI Ratio on STIR images and SUV<sub>max</sub> (P=0.66; p<0.001) as well as SUV<sub>mean</sub> (0.67; p<0.001). Targeted facet block in patients with activated facet arthrosis led to a higher reduction of pain activity than in patients without activated facet arthrosis (VAS reduction 24h post infiltration: -5.2 +/- 1.2 vs. -0.8 +/- 0.4; p=0.004).

### CONCLUSION

18F-FDG PET/MRI can detect activated facet arthrosis and thus might facilitate identification of patients suitable for successful targeted infiltration therapy.

### CLINICAL RELEVANCE/APPLICATION

Identifying suitable patients for facet joint infiltration is important for therapy success. PET/MRI can detect activated facet arthrosis and thus facilitate successful infiltration therapy.

#### SSQ15-04 Volumetric, Metabolic and CSF Biomarkers Profile in Different Subtypes of MCI

Thursday, Dec. 3 11:00AM - 11:10AM Location: S505AB

### Participants

Artur Coutinho, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose  
Fabio H. Porto, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Silvana Prando, DIPLPHYS, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Fabio L. Duran, DSc, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Livia Spindola, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Maira O. Oliveira, MSc, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Patricia H. Vale, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose



Carla R. Ono, MD,PhD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Ricardo Nitirini, MD, PhD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Sonia M. Brucki, MD,DSc, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Carlos A. Buchpiguel, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Mild cognitive impairment (MCI) is a transitional stage between normal aging and dementia, particularly Alzheimer's disease (AD). There are few reports investigating multiple biomarkers of non-amnesic MCI (naMCI) as a single group, in comparison to amnesic subtypes (aMCI) and a normal elderly control group (CG). Our study investigated: a) regional brain glucose metabolism (rBGM) with [<sup>18</sup>F]FDG-PET and volume-based morphometry with magnetic resonance imaging (MRI) of a naMCI group in comparison to CG and aMCI, and b) the profile of amyloid- $\beta$  peptide, tau and p-tau proteins in the cerebrospinal fluid (CSF) of naMCI and aMCI groups.

## METHOD AND MATERIALS

114 subjects composed three groups: naMCI (N = 38), aMCI (N = 46) and CG (N = 30). All subjects underwent brain MRI and [<sup>18</sup>F]FDG-PET. Imaging data was analysed with the software SPM8. A subsample (naMCI = 33, aMCI = 38) underwent a lumbar puncture in order to assess levels of amyloid- $\beta$  peptide, tau and phosphorylated tau protein levels in the CSF.

## RESULTS

There was no difference in demographic characteristics and CSF biomarkers between the naMCI and aMCI groups. Both MCI groups had lower rBGM in relation to CG in the precuneus. Additional right prefrontal lobe hypometabolism was seen in naMCI. aMCI group had bilateral mesial and polar temporal lobe volume reduction in comparison to naMCI and CG. No significant volumetric reduction in mesial temporal lobes was seen in naMCI.

## CONCLUSION

Amnesic MCI showed metabolic and volumetric profiles classically related to MCI due to AD, while naMCI group shared a similar metabolic pattern (reduced precuneus rBGM) and prefrontal hypometabolism, but had fewer areas of volumetric reduction.

## CLINICAL RELEVANCE/APPLICATION

Non-amnesic subtypes (naMCI) present with executive, attention, visuospatial and language dysfunctions. A lower conversion rate to dementia, specially AD, is seen in naMCI than in amnesic MCI. An outstanding question is whether naMCI and aMCI have different biomarker profiles. There are few reports investigating multiple biomarkers of naMCI as a single group in comparison to aMCI and cognitively normal elderly subjects (CG). Our study characterizes naMCI as a heterogeneous group, less related to classical AD and different from aMCI. This group should be better prospectively investigated in order to search for specific biomarkers indicating risk of developing different kinds of neurodegenerative disorders.

## SSQ15-05 The Usefulness of the Dopamine Transporter Volume Estimated by C-11 PE-2I PET/CT in Diagnosing Parkinsonism-Novel Parameter for Quantifying the Total Amount of Dopamine Transporter

Thursday, Dec. 3 11:10AM - 11:20AM Location: S505AB

### Participants

Shigeki Nagamachi, MD, PhD, Miyazaki, Japan (*Presenter*) Nothing to Disclose  
Ryuichi Nishii, MD, PhD, Miyazaki, Japan (*Abstract Co-Author*) Nothing to Disclose  
Youchi Mizutani, Miyazaki, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yoshiro Umemura, MD, Miyakonojo, Japan (*Abstract Co-Author*) Nothing to Disclose  
Ryuichi Ohkubo, Miyakonojyo City, Japan (*Abstract Co-Author*) Nothing to Disclose  
Toshinori Hirai, MD, PhD, Miyazaki, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hiroshi Takashima, Kagoshima, Japan (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

In the diagnosis of Parkinsonism, C-11 PE2I (N-(3-iodoprop-2E-enyl)-2 $\beta$ -carbomethoxy-3 $\beta$ -(4-methyl-phenyl)nortropane) is useful radiopharmaceutical for its high binding selectivity and specificity to dopamine transporter (DAT). The study was done to evaluate the usefulness of novel parameter, dopamine transporter volume (DTV) that was calculated with C-11 PE-2I PET/CT, in diagnosing Parkinsonism.

## METHOD AND MATERIALS

Twenty-six patients with Parkinsonism, 15 idiopathic Parkinson diseases (PD) and 11 Parkinsonism of other cause (PS) were evaluated. All patients were done two kinds of examination, C-11 PE-2I PET/CT and iodine-123-labeled metaiodobenzylguanidine (<sup>123</sup>I-MIBG) myocardial scintigraphy. Three dimensional VOI (volume of interest) was automatically drawn around striatum respectively on C-11 PE-2I PET/CT images. Both sided maximum standardized uptake value (SUVmax) and dopamine transporter volume (DTV) were obtained. The threshold value for calculating DTV was 40% of SUVmax. On MIBG scintigraphy, Heart to mediastinum ratio (H/M) and washout ratio (WR) were calculated from early (E) and delayed (D) chest planar images. Correlation analysis between all C-11 PE-2I PET/CT parameters and MIBG parameters were done. In addition, all parameters were compared between PD and PS.

## RESULTS

Both sides DTV showed positive correlation with both the early and delayed H/M (correlation coefficients were from 0.35 to 0.48). In addition, mean value of both sides DTV in PD were significantly lower compared with those in PS (Right TV: 4.26ml vs. 8.67ml, Left TV: 3.92ml vs. 9.59ml).. However, SUVmax showed no statistical significance.

## CONCLUSION

Novel parameter, dopamine transporter volume (DTV), obtained from C-11 PE-2I PET/CT was useful parameter for quantifying conditions of dopamine transporters in Parkinsonism. In addition, it was also useful parameter in differentiating PD from PS.

## CLINICAL RELEVANCE/APPLICATION

Dopamine transporter volume (DTV) that is calculated by C-11 PE-2I PET/CT will be additional useful indices in the differential diagnosis of Parkinsonism.

## SSQ15-06 The Role of SPECT/CT for Non-visualization in Breast Cancer Sentinel Lymph Node Procedures

Thursday, Dec. 3 11:20AM - 11:30AM Location: S505AB

### Participants

Bas Pouw, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose  
Daan Hellingman, Amsterdam, Netherlands (*Abstract Co-Author*) Employee, Oncovision  
Mariette Kieft, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Wouter Victor Vogel, MD, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Emiel Rutgers, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
Renato Valdes Olmos, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose  
M P. Stokkel, MD,PHD, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Single Photon Emission Computed Tomography with integrated CT (SPECT/CT) is complementarily used to planar lymphoscintigraphy to depict sentinel nodes (SN) in patients with invasive breast cancer. An important indication is SN detection in breast cancer patients showing non-visualization on planar images. In our institution, SN procedures for patients with previous breast surgery and/or radiotherapy, neo-adjuvant chemotherapy led to an increase of non-visualization on planar imaging. The present study is to (re)evaluate the contribution of SPECT/CT in breast cancer patients showing no apparent drainage on planar lymphoscintigraphy in terms of SN identification rate.

### METHOD AND MATERIALS

Between 1st of July 2008 and 6th of November 2014 in total 1982 patients underwent a SN breast procedure, using intratumoral tracer administration. SPECT/CT scans for non-visualization on planar lymphoscintigraphy were acquired for 298 (15%) breast cancer patients. Ninety-one (30.5%) patients had previous surgery or radiation therapy at the same breast prior to the SN procedure and 40 (13.4%) were scheduled for neo-adjuvant chemotherapy. If SN non-visualization persisted on SPECT/CT images, a second radiotracer injection with repeated scintigraphy was performed when logistics allowed this. Univariate analysis was performed to examine if specific subgroups, such as age, BMI, T-stage or previous treatment, have influence on visualization rates of SPECT/CT.

### RESULTS

SPECT/CT visualized one or more SN in 22.8% (68/298). Univariate analysis of subgroups revealed no significant factors influencing SPECT/CT visualization. In patients with persistent non-visualization on SPECT/CT and having a reinjection, the SN visualization rate reached 60.3% (38/63).

### CONCLUSION

The visualization rate of SPECT/CT after non-visualization on planar imaging was lower than the SN visualization after reinjection, in an evaluation including all new breast cancer SN indications. We adjusted our institutional protocol for non-visualization on planar lymphoscintigraphy, reserving SPECT/CT imaging only for patients with persistent absence of drainage after reinjection.

### CLINICAL RELEVANCE/APPLICATION

The indication SN breast SPECT/CT imaging is often debated. We propose an adequate role for SPECT/CT in case of non-visualization on planar imaging and thereby save time and money and above all improve the workflow for breast cancer patients.

## SSQ15-07 Does Tc-99m Tilmanocept Offer Shorter Patient Through-Put Time Than Tc99m Sulfur Colloid for Sentinel Lymph Node Mapping in Malignant Melanoma?

Thursday, Dec. 3 11:30AM - 11:40AM Location: S505AB

### Participants

Charles M. Intenzo, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose  
Sung M. Kim, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Adam Berger, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Tc99m tilmanocept has been recently introduced for radionuclide sentinel lymph node (SLN) mapping and intraoperative identification via hand-held gamma probes. Its rapid movement from the injection sites to the mannose receptors in tumor-draining lymph nodes theoretically should shorten the study time compared to the traditional SLN mapping tracer, Tc99m sulfur colloid (Tc99m SC). The latter had been previously used in our laboratory, which required 40 to 45 minutes after injection for visualization of all lymph nodes in patients with malignant melanoma. Our goal was to determine the minimum scan completion time that Tc99m tilmanocept requires with the objective of expediting subsequent transport to the operating suite.

### METHOD AND MATERIALS

0.5 mCi of Tc99m tilmanocept were injected intradermally in 4 divided doses around the tumor. Images were acquired at 5, 10, 20, 30, and 40 minutes after injection, the same protocol used for Tc99m SC. The presence and number of lymph nodes seen at 20 minutes were compared to that seen at 40 minutes.

### RESULTS

A total of 34 consecutive patients underwent SLN mapping with Tc99m tilmanocept. In all 34 patients, all lymph nodes seen in the final 40-minute image were identified in the 20-minute image.

### CONCLUSION

In malignant melanoma, SLN mapping with Tc99m tilmanocept involves a total imaging time of 20 minutes, i.e. one-half of the time required for Tc99m SC.

### CLINICAL RELEVANCE/APPLICATION

Tc99m tilmanocept is more time-efficient than Tc99m SC for SLN mapping in malignant melanoma thereby facilitating patient

through-put.

### **SSQ15-08 Initial Clinical Experience with Intra-procedural Bremsstrahlung Imaging using a Portable Gamma Camera during Yttrium-90 Microsphere Administration**

Thursday, Dec. 3 11:40AM - 11:50AM Location: S505AB

#### **Participants**

Chadwick L. Wright, MD, PhD, Lewis Center, OH (*Presenter*) Nothing to Disclose  
Bill S. Majdalany, MD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose  
Ali A. Rikabi, MD, Dublin, OH (*Abstract Co-Author*) Nothing to Disclose  
Michael V. Knopp, MD, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose  
Nathan C. Hall, MD, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

The intraarterial administration of Yttrium-90 (90Y) microspheres is clinically used to specifically embolize and locally delivery high-dose radiation therapy to otherwise unresectable malignant/metastatic liver lesions. This 90Y decay produces additional bremsstrahlung radiation that can be detected and imaged with conventional gamma cameras. Typically, bremsstrahlung imaging is performed after 90Y radioembolization to qualitatively assess and verify deposition of 90Y microspheres in the liver.

#### **METHOD AND MATERIALS**

A large field-of-view portable gamma camera (LFOVPGC, Ergo, DigiRad) equipped with a medium-energy collimator was used to image 90Y bremsstrahlung radiation in the interventional suite. Pre-procedural static images of background radioactivity and patient's chest and abdomen were obtained. Dynamic chest imaging was performed during the 90Y microsphere administration to assess for any active 90Y microsphere shunting. Post-procedural static images of the chest and abdomen were also obtained. These LFOVPGC images were then compared with routine post-procedural bremsstrahlung planar and SPECT/CT images (Symbia, Siemens).

#### **RESULTS**

Three 90Y microsphere administrations were included. When compared with routine post-procedural bremsstrahlung imaging, the LFOVPGC yielded evaluable images for qualitatively assessing 90Y biodistribution. In all cases, dynamic imaging of the chest verified no active shunting of 90Y microspheres into the lungs during the radioembolization procedure. Likewise, LFOVPGC imaging confirmed 90Y microsphere deposition in the liver.

#### **CONCLUSION**

These initial findings demonstrate that 90Y bremsstrahlung radiation can be readily imaged with a LFOVPGC in the interventional suite and these images are comparable to routine post-procedural bremsstrahlung images. It appears feasible that intra-procedural LFOVPGC bremsstrahlung imaging can be integrated into the interventional workflow for the purposes of rapid verification of 90Y microsphere deposition in the liver. Further validation of this LFOVPGC imaging approach may obviate the need for subsequent post-procedural bremsstrahlung planar imaging.

#### **CLINICAL RELEVANCE/APPLICATION**

This clinical study evaluates the feasibility for LFOVPGC imaging in the interventional suite to provide real-time imaging assessment of 90Y bremsstrahlung radiation during radioembolization.

### **SSQ15-09 Evaluation and Clinical Quantification of Neoplastic Lesions and Physiological Structures in TOF-PET/MRI and Non-TOF/MRI – A Pilot Study**

Thursday, Dec. 3 11:50AM - 12:00PM Location: S505AB

#### **Participants**

Felipe D. Barbosa, MD, Oberengstringen, Switzerland (*Presenter*) Nothing to Disclose  
Gaspar Delso, PhD, Zurich, Switzerland (*Abstract Co-Author*) Employee, General Electric Company  
Konstantinos G. Zeimpekis, DIPLOPHYS, MSc, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Edwin ter Voert, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Martin W. Huellner, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Paul Stolzmann, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Patrick Veit-Haibach, MD, Zurich, Switzerland (*Abstract Co-Author*) Research Grant, Bayer AG; Resaarch Grant, F. Hoffmann-La Roche Ltd; Research Grant, General Electric Company

#### **PURPOSE**

To clinically assess a new PET/MRI technology in which the PET-component features a new PET- detector and time-of-flight (TOF) technology. Thus, we compared SUVmax/mean of neoplastic lesions and physiological structures between TOF- and non-TOF-PET/MRI imaging. We qualitatively evaluated image quality derived from TOF-PET/MRI, non-TOF-PET/MRI reconstruction and FDG-PET/CT. Lastly we did clinical measurements to evaluate the PET- detector sensitivity in order to better understand the background of our clinical results.

#### **METHOD AND MATERIALS**

Twenty-seven oncological patients were prospectively enrolled and evaluated with FDG-PET/CT and PET/MRI (15 M/ 12 F; mean age 56 ±10 y). Time between injection and PET/CT was 62.4 ±7.6 min, consecutive start of imaging of PET/MRI was 104.6 min±18.2 after injection. To assess the differences between TOF and non-TOF, all PET-images of the PET/MRI were reconstructed twice -with and without TOF. To compare lesion and tissue characterization between both reconstructions, malignant lesions as well as physiological structures were compared. Furthermore, PET image quality, artifacts, image sharpness, noise and lesion detectability were assessed as well. Count rates between both systems were also compared.

#### **RESULTS**

All malignant lesions and the majority of physiologic tissue (except the subcutaneous fat, spleen and blood pool) showed a good correlation concerning SUV (max and mean) measurements between PET/CT, non-TOF and TOF reconstructions. The general image

quality was rated statistically significant superior in non-TOF ( $p < 0.001$ ) and TOF-reconstruction in PET/MRI ( $p < 0.01$ ) compared to PET/CT. Furthermore, TOF-PET/MRI was rated superior concerning image quality ( $p < 0.05$ ) compared to non-TOF PET/MRI. The ratio of emitted/received events between both systems (PET/CT and PET/MRI) was 2.78

#### **CONCLUSION**

PET/MRI with TOF is reliable concerning SUV quantification and image quality. The technical promise of an improved sensitivity of the new PET-detector in this PET/MRI device could be confirmed in a clinical setting.

#### **CLINICAL RELEVANCE/APPLICATION**

PET/MRI with TOF demonstrates reliable SUV quantification and improved image quality compared to non-TOF based and offers superior sensitivity of the PET-detector.

MSCN52

## Case-based Review of Neuroradiology (An Interactive Session)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S100AB



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

### Participants

Pina C. Sanelli, MD, Manhasset, NY (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Improve basic knowledge and skills relevant to clinical practice. 2) Practice formulating a differential diagnosis for pathologic diseases involving the brain, spine, head and neck. 3) Apply principles of critical thinking to challenging diagnostic imaging cases.

### ABSTRACT

The learning objectives are to enable attendees to: 1. Improve basic knowledge and skills relevant to clinical practice. 2. Practice formulating a differential diagnosis for pathologic diseases involving the brain, spine, head and neck. 3. Apply principles of critical thinking to challenging diagnostic imaging cases.

### Sub-Events

#### MSCN52A Pediatric Brain

### Participants

Tina Y. Poussaint, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To select the appropriate modality or modalities in evaluating a suspected or diagnosed case of pediatric CNS disease with focus on MR imaging. 2) To review key MR imaging features of pediatric brain diseases. 3) To evaluate neuroimaging of pediatric CNS disease as it relates to understanding the developing brain in childhood.

### ABSTRACT

Pediatric brain diseases will be discussed in a case based format.

#### MSCN52B Pediatric Spine

### Participants

Christopher G. Filippi, MD, Grand Isle, VT, (cfilippi@nshs.edu) (*Presenter*) Research Consultant, Regeneron Pharmaceuticals, Inc; Research Consultant, Syntactx

### LEARNING OBJECTIVES

1) Identify the basic anatomic, physiologic and pathologic features of diseases affecting the pediatric spine. 2) Identify the key imaging features of various common pediatric spine diseases. 3) Recognize common patterns for spine and spinal cord pathology and organize these patterns into categories of diseases processes.

### ABSTRACT

Common pediatric spine and spinal cord diseases will be discussed in a case-based format.

#### MSCN52C Pediatric Head and Neck

### Participants

Laurie A. Loevner, MD, Gladwyne, PA (*Presenter*) Stockholder, General Electric Company; Stockholder, Pfizer Inc; Stockholder, Merck & Co, Inc; Stockholder, Johnson & Johnson; Stockholder, Amgen Inc; Stockholder, GlaxoSmithKline plc

### LEARNING OBJECTIVES

1) Identify the salient imaging features of common pathologies of the pediatric head and neck. 2) Identify pertinent anatomy in the neck and skull base through the illustration of head and neck pathology. 3) Recognize patterns for disease that allow a succinct differential diagnosis. 4) Apply radiologic findings to identify next appropriate steps in patient work-up.

SSQ12

## Molecular Imaging (New Tracers/Methods)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S504AB

**CT** **MI** **MR** **NM**

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

**FDA** Discussions may include off-label uses.

### Participants

Brian M. Rodgers, MD, Rockville, MD (*Moderator*) Nothing to Disclose  
Bernadette V. Marquez, PhD, Saint Louis, MO (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ12-01 Hyperpolarized 13C MRI for Non-Invasive Assessment of Liver Injury in a Mouse Model

Thursday, Dec. 3 10:30AM - 10:40AM Location: S504AB

### Participants

Michael A. Ohliger, MD, PhD, San Francisco, CA (*Presenter*) Nothing to Disclose  
Irene Marco-Rius, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Robert A. Bok, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Jacquelyn J. Maher, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Cornelius Von Morze, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Subramaniam Sukumar, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Zihan Zhu, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Zhen J. Wang, MD, Hillsborough, CA (*Abstract Co-Author*) Nothing to Disclose  
Benjamin M. Yeh, MD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Author with royalties, Oxford University Press; Shareholder, Nextrast, Inc;  
Daniel B. Vigneron, PhD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company  
John Kurhanewicz, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Liver injury and inflammation may lead to liver fibrosis, portal hypertension and cirrhosis. There is currently no method to image liver inflammation. Hyperpolarized 13C MRI is an emerging tool for imaging metabolism. Increased conversion of [13C]pyruvate to [13C]lactate has been observed in a mouse model of arthritis. We hypothesize that lactate production may be a marker of acute liver injury.

### METHOD AND MATERIALS

11 male CD1 mice were treated via IP injection with either 1 ul/g of the hepatotoxin CCl4 (n=6) to induce liver injury, or with vehicle alone (n=5, control group). Mice were imaged with a 14 T preclinical MRI scanner prior to and 48 hours after treatment. 350 ul of 80mM [1-13C]pyruvic acid was polarized in a Hypersense DNP polarizer (Oxford Instruments) and injected via tail vein. Metabolite images were obtained for pyruvate, alanine and lactate at 29 s using a fast spectrally-selective 3D imaging sequence (resolution 2x2x3.3 mm). Metabolite images were overlaid onto T2 images. An ROI was drawn on the center liver slice avoiding large vessels. Ratios of lactate and alanine to pyruvate were measured. Mice were sacrificed and livers stained for histology. Liver damage graded by an experienced hepatologist blinded to the imaging.

### RESULTS

Imaging was successful in all 11 mice before and after treatment. Histologic liver damage was seen in 5/6 CCl4-treated mice. Mean lactate/pyruvate ratio was significantly higher after CCl4 treatment (2.8, SD 0.9) than for untreated mice (1.8, SD 0.6, p<0.05) or the control group (1.7, SD 0.5, p<0.05). Mean alanine/pyruvate ratio was also significantly higher after CCl4 treatment (2.2, SD 0.6) than for untreated mice (1.3, SD 0.6, p<0.05) or the control group (1.4, SD 0.4, p<0.05). There was no significant difference in either ratio between the pre-treatment and the control group.

### CONCLUSION

Treatment of mice with a single dose of the hepatotoxin CCl4 leads to a significant and rapid rise in hepatic lactate and alanine production measured by hyperpolarized 13C MRI. Future experiments will determine whether the observed lactate and alanine production results from activated inflammatory cells within the liver or metabolic alterations within hepatocytes themselves.

### CLINICAL RELEVANCE/APPLICATION

Hyperpolarized 13C MRI is a promising tool for non-invasively imaging evaluating liver injury and inflammation.

#### SSQ12-02 Synthesis and Characterization of Novel Hydrophilic Molecules for 19F-MR Contrast Imaging

Thursday, Dec. 3 10:40AM - 10:50AM Location: S504AB

### Participants

Eric Tanifum, PhD, Houston, TX (*Presenter*) Nothing to Disclose  
Matthew Liaw, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Robia Pautler, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Ananth Annapragada, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Marval Pharma Ltd Stockholder, Alzeca Biosciences LLC Stockholder, Sensulin LLC Stockholder, Abbott Laboratories Stockholder, Johnson & Johnson

### PURPOSE

Conventional MRI contrast agents employ paramagnetic metal ions to generate contrast in 1H MRI scans. While this approach is

Conventional MRI contrast agents employ paramagnetic metal ions to generate contrast in 1H MRI scans. While this approach is highly sensitive, specificity and unambiguous quantification of signal is challenging and metal ion toxicity is a concern so other alternatives are sought. <sup>19</sup>F presents a great potential for reasons including: spectroscopic properties of <sup>19</sup>F are similar to <sup>1</sup>H therefore existing <sup>1</sup>H MRI hardware can be used for <sup>19</sup>F MRI with minimal modifications; no endogenous <sup>19</sup>F in soft tissue so the potential to generate a directly quantifiable signal with high contrast-to-noise ratio. However, almost all <sup>19</sup>F-based agents utilize perfluorocarbons (PFCs), with several drawbacks: highly hydrophobic (limiting formulation to water emulsions) and magnetically diverse <sup>19</sup>Fs (result in diffuse <sup>19</sup>F MR images). We report novel hydrophilic fluorinated molecules with magnetically equivalent <sup>19</sup>Fs, amenable to aqueous formulations for molecular imaging.

## METHOD AND MATERIALS

Hydrophilic moieties were linked to fluorinated moieties with equivalent <sup>19</sup>Fs, to generate water-soluble monomer units and then condensed to dimers and oligomers with high <sup>19</sup>F content. Structures were confirmed by NMR and MS. Liposome formulation was achieved using standard protocols and size distribution determined by DLS. <sup>19</sup>F content was assessed by UV-VIS and <sup>19</sup>F NMR, and <sup>19</sup>F MRI scans performed using a TurboRARE 3D scan in a 9.4 T Bruker instrument equipped with a <sup>1</sup>H/<sup>19</sup>F dual-tunable volume RF coil.

## RESULTS

Molecular synthesis was achieved in excellent yields, and <sup>1</sup>H and <sup>19</sup>F NMR indicated purity of the final products at >97%. All compounds dissolved readily in saline to give 500 mM to 1 M solutions used to prepare stable liposome formulations. <sup>19</sup>F MR scans showed that formulations are detectable at 2-5 mM concentrations of the molecules, comparable to the high micromolar to millimolar intravoxel concentrations required for Gd contrast detection.

## CONCLUSION

This is a new and facile paradigm to formulate <sup>19</sup>F MRI contrast agents in aqueous media and their use to prepare stable liposome formulations, a proven nanoparticle platform for both passive and active delivery of contrast for molecular imaging, highlights the potential of this approach.

## CLINICAL RELEVANCE/APPLICATION

We believe this approach will have significant impact on molecular imaging.

### SSQ12-03 [<sup>11</sup>C]Me@HAPTHI - A Novel PET-ligand for the Norepinephrine Transporter - Part 1: Target Affinity and Radiosynthesis

Thursday, Dec. 3 10:50AM - 11:00AM Location: S504AB

#### Participants

Christina Rami-Mark, MSc, Vienna, Austria (*Presenter*) Nothing to Disclose  
Neydher Berroteran-Infante, MSc, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Alexander Hoepfing, Radeberg, Germany (*Abstract Co-Author*) Employee, ABX GmbH  
Marcus Hacker, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Markus Mitterhauser, Vienna, Austria (*Abstract Co-Author*) Speaker, General Electric Company  
Wolfgang Wadsak, Vienna, Austria (*Abstract Co-Author*) Speaker, General Electric Company; Consultant, THP Medical; Research Grant, ABX GmbH; Research Grant, Rotem GmbH

#### PURPOSE

The norepinephrine transporter (NET) has been demonstrated to be relevant to a multitude of neuro-psychiatric and cardiovascular pathologies. Due to the wide range of possible applications for PET imaging of the NET together with the limitations of currently available radioligands, novel NET-PET tracers are seriously needed.

#### METHOD AND MATERIALS

Precursor, HAPTHI ((S)-1-(4-amino-3-hydroxybutyl)-3-phenyl-1,3-dihydrobenzo[c][1,2,5]thiadiazole 2,2-dioxide), and reference compound, Me@HAPTHI ((S)-1-(3-hydroxy-4-(methylamino)butyl)-3-phenyl-1,3-dihydrobenzo[c][1,2,5]thiadiazole 2,2-dioxide), were custom-synthesized by ABX. For optimization of radiosynthesis conditions, small-scale reactions (< 2GBq) were performed. The influence of various reaction conditions, i.e. reaction temperature, solvent and base, precursor concentration and radiomethylation agent, was investigated. The automation of the N-<sup>11</sup>C-methylation reaction was done on a TRACERlab FX C Pro synthesizer (GE Healthcare). The affinity of new radiolabeled ligand was determined in a NET-expressing membrane binding protocol.

#### RESULTS

In the radiochemical evaluation, best results were obtained with sodium hydroxide catalysis in 2-butanone (MEK) as solvent for 2min at 75°C using 2mg/mL precursor HAPTHI. Thereby, 54.0 ± 8.3% radiochemical incorporation yield was achieved. These optimum reaction parameters were subsequently used in the fully automated radiosynthesizer. So far, 7 large-scale radiosyntheses were performed, yielding 2.2 ± 2.0GBq (18.9 ± 13.3%, corrected for decay) of sterile, formulated [<sup>11</sup>C]Me@HAPTHI within 36min. A mean specific activity of 46.8±28.5 GBq/μmol was found in the large-scale syntheses. Full radiopharmaceutical quality control took 5min and showed that radiochemical purity always exceeded 98%. Affinity of reference compounds, Me@HAPTHI, using human NET membranes evinced a K<sub>d</sub> of 0.21 ± 0.07nM (n≥9). For determination of selectivity, additionally the affinity towards human DAT and SERT membranes were measured and revealed >10μM for DAT and 409 ± 43nM for SERT, respectively, (n≥5). Hence, selectivity of Me@HAPTHI towards NET was determined as DAT/NET>1947.6 and SERT/NET=9757.

#### CONCLUSION

This study confirms an outstanding affinity and selectivity of the title compound towards human NET as well as its feasible radiochemical preparation for further preclinical evaluations and future in-vivo applications.

#### CLINICAL RELEVANCE/APPLICATION

N/A

### SSQ12-04 [<sup>11</sup>C]Me@HAPTHI - A Novel PET-ligand for the Norepinephrine Transporter - Part 2: Preclinical Evaluation

#### Participants

Christina Rami-Mark, MSc, Vienna, Austria (*Presenter*) Nothing to Disclose  
Wolfgang Wadsak, Vienna, Austria (*Abstract Co-Author*) Speaker, General Electric Company; Consultant, THP Medical; Research Grant, ABX GmbH; Research Grant, Rotem GmbH  
Cecile Philippe, PhD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Chrysoula Vraka, MSc, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Marcus Hacker, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Markus Mitterhauser, Vienna, Austria (*Abstract Co-Author*) Speaker, General Electric Company

#### PURPOSE

The norepinephrine transporter (NET) has been demonstrated to be pivotal in many neuro-psychiatric and cardiovascular pathologies. [<sup>11</sup>C]Me@HAPTHI, a novel potential NET-PET tracer, was shown to have a high target affinity and selectivity. Hence, further in vitro evaluation regarding blood-brain-barrier (BBB) penetration, stability and binding properties in autoradiography on different tissues is required.

#### METHOD AND MATERIALS

LogD was assessed using HPLC (Donovan and Pescatore J Chrom A, 2002). Immobilized artificial membrane (IAM) chromatography was performed using a standard method (Vraka C et al. EJNMMI, 2014) to achieve P<sub>m</sub> (permeability) values. For evaluation of stability, incubation with human liver microsomes was performed. Plasma protein binding was determined quantifying the free fraction (ff) in human pooled plasma (Huang Y et al. J Cereb Blood Flow Metab, 2002). In vitro autoradiography was performed on human brain tissue (cortex, thalamus, hippocampus, cerebellum, and hypothalamus) as well as rat heart. Non-specific binding was determined with excess Nisoxetine (10 μM). For competition, non-radioactive FMeNER-D2 and Me@HAPTHI were added. After 1h at room temperature, incubation was stopped and slices were processed on phosphor imaging films. Post-autoradiographic processing of the slices was done by Nissl staining in order to facilitate morphological mapping. Immunohistochemical (IHC) staining experiments were performed on rat and human tissue cryo-slices, vicinal to the slices used for autoradiography.

#### RESULTS

Excellent affinity (K<sub>d</sub> of 0.21±0.07nM) and selectivity (DAT/NET>1940; SERT/NET=9700) were already shown for [<sup>11</sup>C]Me@HAPTHI. Now, both logD (2.27±0.01) and P<sub>m</sub> (1.15±0.25) were found to be in a range for expectable BBB penetration. After 60min incubation with human liver microsomes, 99.6±0.3% of the tracer were still intact. ff was found to be 8.2±0.3%. In the autoradiographic experiments, highest uptake of [<sup>11</sup>C]Me@HAPTHI was observed in NET-rich regions identified with IHC and a concentration dependent binding displacement was seen for both competitors. (see figure)

#### CONCLUSION

Side from its high affinity and selectivity, we now demonstrated [<sup>11</sup>C]Me@HAPTHI's stability, expectable BBB penetration and specific binding in autoradiography. This encourages us for in vivo application in small animal PET experiments and future clinical trials.

#### CLINICAL RELEVANCE/APPLICATION

N/A

#### SSQ12-05 Multimodal Imaging of Insulin-dependent Triglyceride-rich lipoprotein Uptake into Brown Adipose Tissue at 7T MRI and Intravital Microscopy

Thursday, Dec. 3 11:10AM - 11:20AM Location: S504AB

#### Participants

Caroline Jung, Hamburg, Germany (*Presenter*) Nothing to Disclose  
Markus Heine, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Harald Ittrich, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Jorg Heeren, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Nils Mangels, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The aim was to determine the metabolic activity of brown adipose tissue (BAT) and its dependence on signalling pathway mediated by the anabolic hormone insulin using superparamagnetic iron oxide nanoparticles (SPIO - for MRI) or quantum dots (QD - for intravital microscopy (IVM)) embedded into triglyceride-rich lipoproteins (TRL).

#### METHOD AND MATERIALS

BAT activity of C57BL/6J wild-type was stimulated by treatment with the β3 receptor agonist CL316,243. Inhibition of insulin secretion during the course of BAT activation was performed using the potassium channel agonist diazoxide. All mice were starved for 4 hours before imaging. MRI at 7T ClinScan (Bruker) was performed before and 20 minutes after iv injection of TRL-SPIOs using a T2\*w Multiecho-GRE sequence (TR/TEfirst 400/2ms, ETL 12, ES 1ms, FA 25°). ΔR2\* in BAT was estimated. In addition to the MRI set up, IVM analysis was performed for real time imaging of TRL-QD uptake into BAT. In order to quantify TRL clearance, the fate of radioactively labelled TRLs were analysed under the same experimental conditions.

#### RESULTS

While no signal difference in BAT before and after the injection of TRL-SPIO was detectable for control mice, a significant signal drop and increase of ΔR2\* (82.9s<sup>-1</sup>; p<0.001) was estimated for CL treated, BAT activated mice. Inhibition of insulin signalling resulted in a significant lower uptake of TRL-SPIO into BAT (ΔR2\* = 21.1s<sup>-1</sup>; p<0.001). MRI results were confirmed by IVM analyses and by quantitative metabolic studies using radioactive lipid tracers. In both setups inhibition of insulin secretion using diazoxide abolished TRL uptake into BAT.

#### CONCLUSION

β3-receptor activation via CL with following acute insulin release lead to BAT activation which can be visualised in vivo by MRI



pp receptor activation via CE with following acute insulin release lead to BAT activation, which can be visualised in vivo by MRI using TRL-SPIO and estimating  $\Delta R2^*$ . Accordingly, the inhibition of insulin signalling blocks TRL uptake into BAT. Thus, MRI can visualize physiological lipid processing in the vascular endothelium of activated BAT.

#### CLINICAL RELEVANCE/APPLICATION

MRI in combination with nanoparticle-labelled lipoproteins can be used to noninvasively monitor the molecular pathway of insulin-dependent lipoprotein metabolism.

#### SSQ12-06 Using MPI as High Temporal Resolution Imaging Technique for in Vivo Bolus Tracking of Ferucarbotran in Mouse Model

Thursday, Dec. 3 11:20AM - 11:30AM Location: S504AB

##### Participants

Caroline Jung, Hamburg, Germany (*Presenter*) Nothing to Disclose  
Johannes M. Salamon, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Martin Hofmann, Dipl Phys, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Michael G. Kaul, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Tobias Knopp, DIPL ENG, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Harald Ittrich, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Kolja Them, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

##### PURPOSE

Magnetic particle imaging (MPI) is a new radiologic imaging method, potentially capable of rapid 3D dynamic imaging of magnetic tracer. The goal of this study was to follow and visualize the intravenous injected nanoparticles in real time through cardiovascular system at MPI.

##### METHOD AND MATERIALS

MPI scans of FVB mice (n=4) were carried out using a 3D imaging sequence (1 T/m gradient strength, 10 mT drive-field strength, FOV 40x40x20 mm<sup>3</sup>). After a first baseline control measurement a dynamic scan consisting of 100 000 repetitions (duration of about 35min and temporal resolution of 21.5ms per 3D volume) was performed. After the 13953th repetition 50 $\mu$ l ferucarbotran (Resovist, Bayer Schering Pharma AG) was injected into the tailvein via pump (53.7ml/h). As MPI delivers no anatomic information, MRI scans at 7T ClinScan (Bruker) were performed before and after MPI examination using a T2-weighted 2D turbo spin echo sequence (FOV 32mm, matrix 256x256, TR 1100ms, TE 28ms). The reconstruction was performed on the MPI console (ParaVision 6.0/MPI, Bruker). Image fusion was done using additional image processing software (Imalytics, Philips). The dynamic information was extracted using self-written software using the Julia programming environment.

##### RESULTS

The combined MR-MPI measurements were carried out successfully. No dislocation of the mouse was observed. In the sagittal views it is clearly visible how the tracer enters the vena cava inferior before it moves to the heart and then into the liver. (Fig. 1 shows different time points over a range of 1.5 s). By co-registration with MRI the anatomical regions were identified. Due to the frame rate of about 46 volumes per second a signal modulation with the frequency of the heart beat is detectable and a heart beat of 520bpm can be appreciated. Moreover the bloodflow velocity of approximately 5cm/s in the vena cava can be estimated.

##### CONCLUSION

The high temporal resolution of MPI allows real-time imaging and bolus tracking of intravenous injected nanoparticles and offers a tool to estimate blood flow velocity. MRI was successful used for anatomical informations.

#### CLINICAL RELEVANCE/APPLICATION

Blood flow velocity measurements by MPI may allow the estimation of luminal narrowing in atherosclerotic disease.

#### SSQ12-07 In Vivo Noninvasive Characterization of Brown Adipose Tissue in Rat by Spectral CT

Thursday, Dec. 3 11:30AM - 11:40AM Location: S504AB

##### Awards

##### Molecular Imaging Travel Award

##### Participants

Xin-Gui Peng, MD, PhD, Nanjing, China (*Presenter*) Nothing to Disclose  
Zhen Zhao, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose  
Di Chang, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose  
Shenghong Ju, MD, PhD, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose

##### PURPOSE

Brown adipose tissue (BAT) has lower lipid content, more abundant iron content and mitochondrion compared to white adipose tissue (WAT). Our study is to evaluate the lipid/water and iron/water content in both types of adipose tissue using material decomposition and effective atomic number of spectral CT.

##### METHOD AND MATERIALS

The animal study was approved by the institutional Committee on Animal Research. Six Wistar rats (14 weeks, 304g  $\pm$ 12g) underwent Spectral CT scan (GE, Discovery CT750 HD). Data were transmitted to AW4.6 workstation to obtain base material mappings, including fat (water) based imaging and iron (water) based imaging. The fat/water and iron/water concentration of brown adipose tissue (interscapular) and white adipose tissue (visceral) were measured on base material mapping. In addition, we also calculate the effective atomic number of both types of adipose tissue. Statistical analysis was performed with independent sample t test.

##### RESULTS

The base fat (water) material concentration of BAT was significantly lower than that of WAT ( $587.29 \pm 187.61 \text{mg/cm}^3$  and  $1587.43 \pm 70.11 \text{mg/cm}^3$ , respectively;  $P < 0.001$ ). However, the water (fat) concentration of BAT was significantly higher than that of WAT ( $395.81 \pm 189.53 \text{mg/cm}^3$ , and  $-655.1 \pm -69.141 \text{mg/cm}^3$ , respectively;  $P < 0.001$ ). The based iron (water) material concentration of BAT was significantly higher compared to WAT ( $-4.92 \pm 1.80 \text{mg/cm}^3$  and  $-13.80 \pm 0.36 \text{mg/cm}^3$ , respectively;  $P < 0.001$ ). Water (iron) concentration of BAT was also higher than that of WAT ( $989.33 \pm 7.29 \text{mg/cm}^3$  and  $951.63 \pm 5.49 \text{mg/cm}^3$ , respectively;  $P < 0.001$ ). The effective atomic number of BAT was significant higher than that of WAT ( $6.95 \pm 0.28$  and  $4.7 \pm 0.11$ , respectively;  $P < 0.001$ ).

## CONCLUSION

The quantification of base material concentration and effective atomic number analysis of spectral CT revealed different characterization of both types of adipose tissue.

## CLINICAL RELEVANCE/APPLICATION

It is anticipated that spectral CT provided a new noninvasive method to be translated to a clinical setting for evaluating the difference of adipose tissue and monitoring the responses to specific therapeutic strategies.

### SSQ12-08 Does Iterative CT Reconstruction for Attenuation Correction Impact PET Images? A Qualitative and Quantitative Assessment for Next-Generation Digital Detector PET/CT

Thursday, Dec. 3 11:40AM - 11:50AM Location: S504AB

#### Awards

##### Molecular Imaging Travel Award

#### Participants

Katherine Binzel, PhD, Columbus, OH (*Presenter*) Nothing to Disclose  
Jun Zhang, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose  
Philip Bardos, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose  
Veena A. Nagar, MD, Dublin, OH (*Abstract Co-Author*) Nothing to Disclose  
Michael V. Knopp, MD, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Implementation of iterative CT reconstruction (ICR) allows for significant dose reduction while generating equivalent visual quality to conventional CT doses. In this study we determine if there is any quantitative impact of using ultra-low dose ICR for attenuation correction of PET data, compared to filtered back projection (FBP).

#### METHOD AND MATERIALS

Clinical patients received 13 mCi FDG prior to imaging on the Vereos TF 64 PET/CT (Philips). Attenuation CTs were performed using 120 kV and 50 mAs for the PET imaging volume, skull to mid-thighs. PET images were reconstructed in two different modes, standard CT FBP and iDose4 ICR. The PET images were visually and quantitatively evaluated in a blinded fashion. The quantitative assessment focused on ROI assessment in target lesions in patients and background tissues.

#### RESULTS

A total of 30 datasets from 15 patients were evaluated. On visual assessment of the PET images benefits from the use of ICR for attenuation correction were apparent with markedly reduced impact from streaking artifacts. The quantitative analysis revealed that the overall SUVmax of PET images with iteratively reconstructed attenuation CTs was 0.5% higher for all tissue types [non-significant difference]. In target lesions the percent difference ranged from 0.5% to 1.4% increased SUVmax's over SUVmax's determined from PET images with FBP CT, none having any lower values.

#### CONCLUSION

Iterative CT reconstruction enables significant reduction of the x-ray dose required to obtain attenuation correction images for PET. This study validates that there is no impact on the quantitative readout compared to FBP reconstructed attenuation CTs. The visual appearance of the PET images appeared to be improved at locations where streaking artifacts were visible on FBP reconstructed CTs. Iterative reconstructed CTs can and should be used on next-generation PET/CT systems.

#### CLINICAL RELEVANCE/APPLICATION

Iterative CT reconstruction enables significant reduction of the x-ray dose required to obtain attenuation correction images for PET, while simultaneously improving the appearance of image artifacts.

### SSQ12-09 Generalized Syntheses of Tumor Targeted Yolk/Shell Structured Multifunctional Nanosystems

Thursday, Dec. 3 11:50AM - 12:00PM Location: S504AB

#### Awards

##### Molecular Imaging Travel Award

#### Participants

Christopher England, PhD, Madison, WI (*Presenter*) Nothing to Disclose  
Feng Chen, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Hao Hong, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Shreya Goel, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Stephen Graves, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Todd Barnhart, Madison, WI (*Abstract Co-Author*) Nothing to Disclose  
Weibo Cai, PhD, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The purpose of this work is to develop a generally applicable protocol for synthesizing yolk/shell structured multifunctional nanosystems to be used for tumor targeted PET image-guided drug delivery.

## **METHOD AND MATERIALS**

Upconversion nanoparticle (UCNP, with NIR-in-NIR-out upconversion luminescence) was used as the initial example. UCNP was first coated with a dense silica (dSiO<sub>2</sub>) shell, forming UCNP@dSiO<sub>2</sub>, followed by re-growth of a shell-thickness controllable mesoporous silica nanoshell (MSN) to form UCNP@dSiO<sub>2</sub>@MSN. A Na<sub>2</sub>CO<sub>3</sub> etching protocol was used to selectively etch away dSiO<sub>2</sub>, leaving behind yolk/shell structured nanoparticles denoted as UCNP@HMSN. A step-by-step surface engineering process was then adopted to conjugate (or label) NOTA, polyethylene glycol (PEG) linkers, TRC105 (an anti-CD105 antibody), and <sup>64</sup>Cu to form <sup>64</sup>Cu-UCNP@HMSN-PEG-TRC105. Both hydrophobic (i.e. Sunitinib) and hydrophilic (i.e. Doxorubicin) drugs could be loaded inside UCNP@HMSN. Systematic in vivo PET imaging and biodistribution studies were performed in 4T1 tumor-bearing mice to evaluate and confirm tumor targeting capability, validated by in vitro/ex vivo studies.

## **RESULTS**

TEM confirmed successful synthesis of UCNP@HMSN. By changing the 'yolk' to superparamagnetic iron oxide nanoparticle (SPION) or quantum dot (QD), we confirmed the general applicability of this protocol. In vitro CD105 targeting in HUVEC (CD105+) and MCF-7 (CD105-) cells showed strong/specific binding of FITC-conjugated UCNP@HMSN-PEG-TRC105 to CD105+ cells with negligible non-specific binding. In vivo tumor targeting and PET imaging demonstrated CD105-specific targeting of <sup>64</sup>Cu-UCNP@HMSN-PEG-TRC105 in 4T1 tumor-bearing mice, with peak tumor uptake of ~6.5 %ID/g at 6 h post-injection. CD105 specificity was confirmed by blocking and ex vivo histology studies.

## **CONCLUSION**

This work demonstrates the feasibility of developing targeted yolk/shell structured nanosystems for in vivo imaging. With UCNP, QD, SPION, or other nanocrystals inside each yolk/shell structure, this nanoplatform is highly versatile for future tumor targeted multimodality image-guided drug delivery.

## **CLINICAL RELEVANCE/APPLICATION**

We report the generalized syntheses of yolk/shell structured nanosystems for tumor targeted PET imaging and drug delivery, with potential future applications as theranostic agents for the concurrent imaging and treatment of cancer.

RCC52

## Practical Informatics for the Practicing Radiologist: Part Two (In conjunction with the Society for Imaging Informatics in Medicine)

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



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

### Participants

### Sub-Events

#### RCC52A Saving Your Body (and Your Mind): Redesigning the Radiology Reading Environment

##### Participants

Eliot L. Siegel, MD, Severna Park, MD (*Presenter*) Research Grant, General Electric Company; Speakers Bureau, Siemens AG; Board of Directors, Carestream Health, Inc; Research Grant, XYBIX Systems, Inc; Research Grant, Steelcase, Inc; Research Grant, Anthro Corp; Research Grant, RedRICK Technologies Inc; Research Grant, Evolved Technologies Corporation; Research Grant, Barco nv; Research Grant, Intel Corporation; Research Grant, Dell Inc; Research Grant, Herman Miller, Inc; Research Grant, Virtual Radiology; Research Grant, Anatomical Travelogue, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, Toshiba Corporation; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Bayer AG; Research, TeraRecon, Inc ; Medical Advisory Board, Bracco Group; Researcher, Bracco Group; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Researcher, Microsoft Corporation

##### LEARNING OBJECTIVES

1) Describe three issues with human factors related to the modern reading room. 2) Indicate potential solutions for lighting, ambient noise, and ergonomic challenges.

#### RCC52B Changing Information Systems: A Survival Guide

##### Participants

Steven C. Horii, MD, Philadelphia, PA (*Presenter*) Spouse, Employee, Cerner Corporation; ;

##### LEARNING OBJECTIVES

1) Describe common issues facing departments changing vendors. 2) Explain the techniques that can be used at time of contracting to ensure future access to data. 3) List techniques used for image migration.

#### RCC52C So Many Images, So Little Time: Advanced Imaging Techniques

##### Participants

Adam E. Flanders, MD, Penn Valley, PA, (adam.flanders@jefferson.edu) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) To appreciate the diversity of advanced visualization techniques. 2) To understand how advanced visualization extends the value of medical imaging. 3) To learn how advanced visualization has changed traditional workflow strategies. 4) To appreciate some of the pitfalls of automation and the need for expert supervised assessment of advanced visualization output.

##### ABSTRACT


SSQ02

## Cardiac (PET CT, PET MRI and SPECT)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S502AB



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

 Discussions may include off-label uses.

### Participants

Rainer K. Rienmueller, MD, Graz, Austria (*Moderator*) Nothing to Disclose  
Seth J. Kligerman, MD, Denver, CO (*Moderator*) Nothing to Disclose  
W. Brian Hyslop, MD, PhD, Chapel Hill, NC (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ02-01 Optimal Scan Timing for Transluminal Attenuation-gradient Coronary CT Angiography Using a Contrast-material Flow Phantom

Thursday, Dec. 3 10:30AM - 10:40AM Location: S502AB

### Participants

Yoshinori Funama, PhD, Kumamoto, Japan (*Presenter*) Nothing to Disclose  
Toshiaki Shimonobo, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose  
Takashi Shirasaka, BS, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose  
Daisuke Utsunomiya, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose  
Seitaro Oda, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose  
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### PURPOSE

The transluminal attenuation gradient (TAG), the gradient of intraluminal radiological attenuation, is a novel index that improves the classification of coronary artery stenosis in coronary CT angiography (CCTA). However, the quantitative TAG value affected by the scan timing after the injection of contrast material because it is calculated from the difference between the pre- and post-stenosis CT numbers. Using a flow phantom and a 320-MDCT volume scanner we investigated the quantitative TAG value at different scan timing points after contrast material injection for coronary CT angiography.

### METHOD AND MATERIALS

Using a contrast-material flow phantom we performed one-volume scans on a 320-MDCT volume scanner (Aquilion ONE ViSION, Toshiba). We employed two types of connecting tubes mimicking 0% and 70% stenosis. The heart rate (HR) was set at 60 bpm, cardiac output at 2.0 and 4.0 l/min; the injection volume of contrast material was 40 ml delivered in the course of 10 sec. Flushing was with 20 ml of physiological saline. The tube voltage and rotation time were 120 kVp and 275 msec. Acquisition of the 80-mm coverage area (160 x 0.5 mm) along the z-axis was started 5.0 sec post-injection and repeated at 0.5 sec intervals for 40 sec with no table movement. We measured the CT numbers on the same slice level and calculated the time density curve (TDC) for 40 sec at 0.5-sec intervals. The TAG value was also calculated from the difference in the CT number obtained at 0% and 70% stenosis at each time point.

### RESULTS

At 70% stenosis and a cardiac output of 2.0 l/min, the time to peak enhancement (PE) from the arrival time was 15.5 sec. In contrast, the time from the arrival time for the lowest TAG value was 6.5 sec at -6.6 Hounsfield units (HU)/cm, i.e. 9.0 sec earlier from the time to PE. At the same time point of 6.5 sec from the arrival time, The TAG value at 0% stenosis was -1.4 HU/cm. At 70% stenosis and a cardiac output of 4.0 l/min, the time for the lowest TAG was 6.0 sec earlier and the TAG value was -4.0 HU/cm; it was -1.7 HU/cm at 0% stenosis.

### CONCLUSION

The TAG value depends on the scan timing after contrast material injection and optimal scan timing dose not correspond to the time to peak enhancement.

### CLINICAL RELEVANCE/APPLICATION

The time to PE differs by 6.0-9.0 sec when the TAG value is obtained with optimal scan timing on a 320-MDCT volume scanner.

#### SSQ02-02 Feasibility Study of Low Tube Voltage (80kVp) Coronary CT Angiography with Knowledge Based Iterative Reconstruction on Patients with BMI 20-25

Thursday, Dec. 3 10:40AM - 10:50AM Location: S502AB

### Participants

Fan Zhang, PhD, Sanya, China (*Presenter*) Nothing to Disclose  
Li Yang, MD, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To investigate the feasibility of low tube voltage (80kVp) coronary CT angiography with knowledge based iterative reconstruction (IMR, Philips Healthcare) on BMI20-25 patients by comparing to images acquired with clinical routine protocols.

### METHOD AND MATERIALS

Coronary CT angiography scans were acquired using a 256-slice MSCT (Brilliance iCT, Philips Healthcare) on 94 patients with body

mass index (BMI, 20-25 kg/m<sup>2</sup>) who were randomly assigned into 2 groups. The scan protocol for group 1 was 100kVp, 600mAs with 70ml contrast medium at an injection rate of 4.5 to 5.5ml/s, and images were reconstructed by a hybrid iterative reconstruction technique (iDose4, Philips Healthcare), while the protocol for group 2 was 80kVp, 600mAs with 35ml contrast medium at an injection rate of 3.5 to 4.5ml/s, and images were reconstructed with IMR. The mean image noise and CNR of different groups were measured on CT images and compared using the paired-t test. In addition, image quality evaluation was performed by two radiologists who were blinded to scan protocol, using a five-point scale (1 [poor] to 5 [excellent]). The results of the two groups were compared between two groups with the Mann-Whitney U-test.

## RESULTS

Compared to group 1, group 2 reduced the iodine delivery rate by 52.4% from 2.1±0.5 gI/s to 1.0±0.5 gI/s and the effective radiation dose by 56.4% from 5.5±1.4 mSv to 2.4±1.2mSv. The mean CT attenuation, CNRs and image quality of all segments on group2 were significantly improved compared to those on group1 (all, p<0.01).

## CONCLUSION

By using of knowledge based iterative reconstruction technique, an ultra-low tube voltage combining with low contrast medium protocol for cCTA can reduce both radiation dose and contrast medium dose with even better image quality.

## CLINICAL RELEVANCE/APPLICATION

The use of 80kV-IMR with low injection dose protocols offers even lower image noise and better image quality especially of distal segments despite a 56.4% radiation dose reduction and a 52.4% contrast medium dose reduction when compared to 100kV-HIR with standard injection dose protocols on non-obese patients.

## SSQ02-03 Myocardial Triglyceride and Left Ventricular Systolic Function: A Cross-Sectional CMR Study in Post-Acute Hospitalization Heart Failure Patients

Thursday, Dec. 3 10:50AM - 11:00AM Location: S502AB

### Participants

Pen-An Liao, MD, Taipei City, Taiwan (*Presenter*) Nothing to Disclose  
Gigin Lin, MD, Guishan, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Shang-Yueh Tsai, Taipei, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Chao-Hung Wang, Keelung City, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Yu-Hsiang Juan, MD, Taoyuan, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Yu-Ching Lin, MD, Tao Yuan, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Ming-Ting Wu, MD, Kaohsiung, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Lan-Yan Yang, Guishan, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Min-Hui Liu, Keelung City, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Tsun-Ching Chang, Keelung City, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
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Yu-Chieh Huang, Keelung City, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Pei-Ching Huang, Taoyuan City, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Jiun-Jie Wang, Taoyuan City, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Koon-Kwan Ng, Guishan, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Shu-Hang Ng, MD, Taoyuan, Taiwan (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Myocardial triglyceride (TG) is related to increased risk of heart disease. However, its relation with cardiac function in recovery status of acute heart failure (HF) has not been investigated. We aim to study the association between myocardial TG content measured on magnetic resonance spectroscopy (1H-MRS) and left ventricular (LV) function revealed on cardiac MR (CMR) in post-acute hospitalization HF patients.

## METHOD AND MATERIALS

We enrolled 50 HF patients discharged from acute hospitalization 6-12 month ago and recruited 21 age- and gender-matched normal controls. Myocardial TG content as well as the left ventricular (LV) function and LV mass was measured by using a 3.0 T MR system. Myocardial TG resonances, comprising fatty acid (FA) and unsaturated fatty acid (UFA), were analyzed and normalized with water (W) signal by using the LC-Model algorithm. According to their LV ejection fraction (LVEF) at the time of CMR examination, our patients was dichotomized into the low LVEF group (LVEF < 50%) and the normal LVEF group (LVEF ≥ 50%).

## RESULTS

There were 48 patients and 21 controls with successful 1H-MRS available for analysis. Among our 48 patients, 25 had their low LVEF (mean, 31.2%) while the other 23 had normal LVEF (mean, 60.2%). Myocardial UFA/W, but not TG/W or FA/W, showed significant differences among the low LVEF group, the normal LVEF group and the control group (7.9% vs 2.1% vs 1.4%, p = 0.02). Myocardial UFA/TG was strongly correlated with LV mass (r = 0.39, p < 0.001) and marginally correlated with LV end-diastolic volume (LVEDV) (r = 0.24, p = 0.039), while myocardial FA/TG was negatively correlated with LV mass (r = -0.39, p < 0.001) and LVEDV (r = -0.24, p = 0.039).

## CONCLUSION

Increased myocardial UFA was observed in post-acute hospitalization HF patients as compared with controls, with a significantly higher level of UFA in the low LVEF group than in the normal LVEF group. Myocardial UFA was strongly correlated with LVEDV, LV mass and, to a lesser degree, cardiac output. We believe that metabolic imaging for measurement of myocardial UFA content by 1H-MRS may be useful for noninvasive evaluation for HF patients post-acute hospitalization.

## SSQ02-04 13N-ammonia PET/MR Myocardial Stress Perfusion Imaging Early Experience

Thursday, Dec. 3 11:00AM - 11:10AM Location: S502AB

### Participants

Amir K. Durrani, MD, St Louis, MO (*Presenter*) Nothing to Disclose

Jeffrey M. Lau, MD, PhD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Richard Laforest, PhD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Jie Zheng, PhD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Agus Priatna, PhD, Ballwin, MO (*Abstract Co-Author*) Research Consultant, Siemens AG Employee, Siemens AG  
Robert J. Gropler, MD, Saint Louis, MO (*Abstract Co-Author*) Advisory Board, Bracco 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  
Pamela K. Woodard, MD, Saint Louis, MO (*Abstract Co-Author*) Research Consultant, Bristol-Myers Squibb Company; Research Grant, Astellas Group; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Bayer AG; Research agreement, Siemens AG; Research Grant, Actelion Ltd; Research Grant, Guerbet SA; ; ;

## PURPOSE

Simultaneous acquisition Positron Emission Tomography/Magnetic Resonance (PET/MR) is a new technology with potential use in cardiac perfusion imaging. Pharmacologic stress perfusion imaging with <sup>13</sup>N-ammonia-PET and MR have previously been validated separately for detection of coronary artery disease (CAD). In this pilot study, we optimize a protocol for comprehensive cardiac PET/MR stress perfusion imaging, and evaluate its diagnostic accuracy for CAD when compared to GSPECT-MPI.

## METHOD AND MATERIALS

15 patients with reversible myocardial perfusion defect on GSPECT-MPI for whom standard of care coronary angiography was planned were recruited. Patients received 400mcg Regadenoson, followed 30 seconds later by simultaneous <sup>13</sup>N-Ammonia-PET (10.2 +/- 0.46 mCi) and gadolinium-based (0.075 mmol/Kg) contrast MR perfusion imaging. The procedure was repeated at rest. PET attenuation correction  $\mu$ -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. The presence and absence of ischemia and infarction were assessed by two independent readers. Areas of decreased perfusion on MRI were correlated to PET myocardial blood flows (MBF) as measured by 2-compartment modeling analysis.

## RESULTS

PET/MR demonstrated excellent concordance with coronary angiographic findings. In this small data set, when compared to GSPECT-MPI, combined PET/MR demonstrated superior diagnostic accuracy (69% vs 54%). The inter-reader concordance was 77%. Using PET/MR as a diagnostic tool for CAD, in this small cohort, there is a 100% sensitivity, 100% negative predictive value, and a 64% positive predictive value.

## CONCLUSION

Early experience with <sup>13</sup>N-PET/MR perfusion imaging showed excellent diagnostic accuracy, sensitivity and specificity for CAD detection.

## CLINICAL RELEVANCE/APPLICATION

Perfusion PET/MR offers a comprehensive myocardial ischemic evaluation. Potential benefits including shorter exam time than SPECT, lower radiation dose, absolute myocardial blood flow quantification, and internal validation between PET and MR findings.

## SSQ02-05 Doppler-Ultrasound in Comparison to Electrocardiogram and Pulse Oximetry for Gating Cardiac MRI at 3T

Thursday, Dec. 3 11:10AM - 11:20AM Location: S502AB

### Participants

Fabian Kording, Hamburg, Germany (*Presenter*) Nothing to Disclose  
Jin Yamamura, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Gunnar K. Lund, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Friedrich Uberle, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Caroline Jung, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Bjoern Schoennagel, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Electrocardiogram (ECG) triggering for cardiac magnetic resonance (CMR) may be influenced by magnetic interferences with increasing magnetic field strength. Doppler Ultrasound (DUS) is not objected to magneto-hydro-dynamic effects (MHD) and does not interact with the electromagnetic field of the MRI. The purpose of this study was to evaluate the performance of Doppler ultrasound (DUS) as a trigger technique for CMR in comparison to ECG and pulse oximetry (POX) at 3 Tesla.

## METHOD AND MATERIALS

Balanced Turbo Field Echo 2D short axis cine CMR and 2D phase-contrast angiography of the ascending aorta was performed in 11 healthy volunteers using ECG, DUS and POX for CMR. The E-wave in early diastole was selected for DUS trigger time points to obtain a marker for quiescent heart phases which were subsequently compared to quiescent heart phases determined manually based on ECG triggered cine images by two observer. Trigger signals were recorded simultaneously in reference to standard ECG trigger signals and compared in terms of trigger quality. Image quality was assessed by endocardial border sharpness (EB) and functional assessment in terms of LV volumetry and aortic blood flow velocimetry.

## RESULTS

The mean sensitivity of trigger recognition for all sequences was similar between DUS (99±1%), ECG (99±1%) and POX (99±1%). DUS trigger points correlated strong with manually determined cardiac quiescence (R=0.9, Obs. 1; R=0.9, Obs. 2). Mean EB averaged over the entire cardiac cycle was similar for ECG, DUS and POX with no significant differences (pECG/DUS = 0.6; pECG/POX = 0.5; pDUS/POX = 0.8). Early diastolic EB was significantly reduced for DUS compared to ECG (pECG/DUS = 0.007) and POX (pDUS/POX=0.03), but not for ECG versus POX (pECG/POX=0.3). Mean EDV (pECG/DUS=0.8, pECG/POX=0.7), ESV (pECG/DUS=0.9, pECG/POX=0.6) and mean aortic velocity (pECG/DUS=0.6, pECG/POX=0.6) were not significantly different.

## CONCLUSION

This study demonstrated the feasibility of DUS for gating human CMR at 3T. With the benefit of not being influenced by

This study demonstrated the feasibility of DUS for gating human CMR at 3T, with the benefit of not being influenced by electromagnetic interferences DUS may offer an alternative trigger technique at high magnetic field environments.

#### CLINICAL RELEVANCE/APPLICATION

Doppler ultrasound measures physiological motion of the heart rather than electrical activation and, hence, may enable a more accurate gating, especially for higher field strength.

#### SSQ02-06 Hybrid Cardiac 18F-FDG PET/MRI in Patients with Suspected Myocarditis

Thursday, Dec. 3 11:20AM - 11:30AM Location: S502AB

##### Awards

##### RSNA Country Presents Travel Award

##### Participants

Felix Nensa, MD, Essen, Germany (*Presenter*) Nothing to Disclose  
Ercan Tezgaç, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Thorsten D. Poeppel, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Till Neumann, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Nico Reinsch, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Peter Krings, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Amir Sabet, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Juliane Schelhorn, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Kai Nassenstein, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Thomas W. Schlosser, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose

##### PURPOSE

To evaluate the diagnostic performance of hybrid 18F-FDG PET/MRI in comparison to late gadolinium-enhancement (LGE) and T2-weighted imaging in patients with suspected myocarditis.

##### METHOD AND MATERIALS

A total of 60 consecutive patients (24 female, age: 35±13 y) with suspected myocarditis were prospectively assessed using integrated cardiac 18F-FDG PET/MRI (mMR Biograph, Siemens Healthcare). The MR imaging protocol consisted of functional cine images, T2-weighted triple inversion recovery images and LGE images 10 minutes after injection of gadobutrol. PET data acquisition was performed simultaneously to MR imaging. Physiological glucose uptake in the myocardium was suppressed with a high-fat, low-carbohydrate diet and i.v. administration of unfractionated heparin. Consent diagnosis by three experienced cardiologists, who were blinded to PET/MR data, was used as standard of reference.

##### RESULTS

PET/MRI examination was successful in 50 of 60 enrolled patients: 2 patients were excluded due to incomplete PET/MRI examinations because of claustrophobia, 8 patients were excluded due to failed inhibition of physiological myocardial glucose uptake. No significant difference in left ventricular ejection fraction was found between patients with clinical evident myocarditis and those clinically diagnosed as not having myocarditis (59.2±7.2% vs. 60.3±12.8%, p=0.298, n=50). Sensitivity and specificity of LGE for the detection of clinically evident myocarditis were 71% and 88% (80% accuracy). Sensitivity and specificity of T2-weighted imaging for the detection of clinically evident myocarditis were 58% and 88% (74% accuracy). Sensitivity and specificity of PET for the detection of clinically evident myocarditis were 75% and 88% (82% accuracy). Odd ratios for the detection of myocarditis were 5.5 for LGE, 5.0 for T2-weighted imaging and 7.0 for PET. Of all combinations, the best diagnostic performance was obtained when at least one of three parameters (LGE, T2, PET) was positive in the same patient yielding 92% sensitivity, 81% specificity, and 86% diagnostic accuracy.

##### CONCLUSION

Hybrid 18F-FDG PET/MRI can improve the non-invasive diagnosis in patients with suspected myocarditis.

#### CLINICAL RELEVANCE/APPLICATION

FDG PET/MRI might guide the therapeutic strategy in patients with suspected myocarditis by providing a more accurate diagnosis and - with FDG uptake - a surrogate parameter for the activity of inflammation.

#### SSQ02-07 Correlating Corrected Coronary Opacification Gradients to PET Myocardial Perfusion: CT Angiography in Functional Assessment of Coronary Lesions

Thursday, Dec. 3 11:30AM - 11:40AM Location: S502AB

##### Participants

Leonid Chepelev, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose  
Ran Klein, PhD, Ottawa, ON (*Abstract Co-Author*) Consultant, Jubilant DraxImage Inc; Shareholder, Jubilant DraxImage Inc  
Brittany Reiche, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose  
Benjamin Chow, MD, Ottawa, ON (*Abstract Co-Author*) Research Grant, General Electric Company Support, TeraRecon, Inc  
Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Abstract Co-Author*) Research Grant, Toshiba Corporation;

##### PURPOSE

To explore the potential use of corrected coronary opacification (CCO) gradients in predicting functional severity of coronary artery disease as assessed by PET myocardial perfusion imaging.

##### METHOD AND MATERIALS

We retrospectively evaluated 42 consecutive patients who underwent CCTA and 82Rb PET MPI within 180 days of each other. CCO was defined as mean coronary intraluminal attenuation normalized to mean aortic attenuation within the same axial slice. Coronary artery geometries and corresponding CCO measurements were automatically derived based on expert vessel centerline annotations with a 1.5mm diameter cutoff and fused with PET perfusion polar maps using software developed by our group in Java and MATLAB. CCO gradients, corrected and uncorrected by coronary artery diameter, were measured in the distal, proximal, and entire coronary



arteries, excluding non-diagnostic, calcified, stenotic, and stented regions. The CCO gradients were correlated to PET myocardial perfusion in the immediate vessel vicinity and projected perfusion territory of a given vessel.

## RESULTS

The maximal Pearson correlation coefficients were observed when considering distal 40% vessel segments and immediately adjacent ( $\pm 30$  degrees on polar map) perfusion territories while omitting calcific and stenotic vessel regions. For the correlation between CCO and PET myocardial perfusion in the immediate vicinity, this yielded absolute Pearson correlation coefficients of  $0.71 \pm 0.18$ ,  $0.70 \pm 0.25$ , and  $0.80 \pm 0.23$  for LAD, LCX, and RCA respectively. Correction of CCO by vessel diameter at the distal 40% vessel segments yielded coefficients that were not significantly different:  $0.70 \pm 0.20$ ,  $0.70 \pm 0.24$ , and  $0.80 \pm 0.22$ , respectively.

## CONCLUSION

The correlation between CCO gradients and PET MPI data supports their use in functional lesion assessment.

## CLINICAL RELEVANCE/APPLICATION

Corrected coronary opacification gradients may supplement functional assessment of coronary artery lesions and potentially predict the functional status of the myocardium using existing CCTA data.

### SSQ02-08 Quantitative Assessment of Diffuse Myocardial Fibrosis in Patients with Diabetic Cardiomyopathy by T1-Mapping: Correlates with Diabetic History

Thursday, Dec. 3 11:40AM - 11:50AM Location: S502AB

#### Participants

Xiao-Chun Zhang, Chongqing, China (*Presenter*) Nothing to Disclose  
Shang Yongning, Chongqing, China (*Abstract Co-Author*) Nothing to Disclose  
Jun Zhao, Chongqing, China (*Abstract Co-Author*) Nothing to Disclose  
Tianjing Zhang, Beijing, China (*Abstract Co-Author*) Employee, Siemens AG  
Jian Wang, Chongqing, China (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The purpose of this study was to use cardiac magnetic resonance (CMR) T1-mapping technique to evaluate diffuse myocardial fibrosis and to explore its relationship with diabetic history.

#### METHOD AND MATERIALS

Thirty three patients with diabetic cardiomyopathy (DCM) (16 men, 17 women, mean age  $46 \pm 8$  years) and 48 healthy controls were performed in Siemens Trio 3.0T, the WIP sequence. T1 Mapping was used for measurement of T1 values, ECV values were calculated from pre and post T1 values. The results' correlation with patients' diabetic history were analyzed as well.

#### RESULTS

Pre-contrast myocardial T1 time and myocardial extracellular volume (ECV) in patients with DCM was significantly higher than the measurement in control cases, and post-contrast myocardial T1 time in DCM patients was significantly lower than that in control cases ( $p < 0.001$ , respectively). In DCM patients, diabetic history was correlated with pre-contrast T1, ECV and post-contrast T1 ( $r = 0.92, 0.95$  and  $-0.93$ , respectively.  $p < 0.001$ ).

#### CONCLUSION

Diffuse myocardial fibrosis in patients with DCM can be assessed by CMR T1-mapping. The study results demonstrate that increased diabetic history is likely to be a major contributor to the severity of diffuse myocardial fibrosis.

#### CLINICAL RELEVANCE/APPLICATION

As a new imaging modality, CMR T1-mapping can provide four dimensional data to quantitatively assess the severity of diffuse myocardial fibrosis in DCM patients, which is useful for the clinical decision.

### SSQ02-09 Rate of Incidental Findings at Myocardial Perfusion Scintigraphy

Thursday, Dec. 3 11:50AM - 12:00PM Location: S502AB

#### Participants

Andrea O. Vergara Finger, MD, Burlington, VT (*Presenter*) Nothing to Disclose  
Sean Reynolds, MD, Burlington, VT (*Abstract Co-Author*) Nothing to Disclose  
Janusz K. Kikut, MD, Burlington, VT (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The SNMMI/ASNC/SCCT consensus guidelines on cardiac SPECT/CT and PET/CT advocate for reporting of incidental findings (IF) on noted on PET/CT and SPECT/CT and SPECT cardiac imaging. However, the definition of a reportable incidental finding is left to the discretion of the interpreting physician. The incidence of IF is reported at 34% in the literature; however, the incidence of clinically important findings is significantly lower, reported as around 5%. However, image quality is often quite different between SPECT/CT and PET/CT with image quality substantially better for the latter. We retrospectively evaluated the rate of IF defined as an unknown or potentially unknown new diagnosis and compared the rate in SPECT/CT as compared to PET/CT to see if the improved image quality available at PET/CT affected the IF rate.

#### METHOD AND MATERIALS

A total of 10,520 Sestamibi SPECT/CT and Rb-82 PET/CT cardiac studies performed at our institution in from 2011-2014 were retrospectively evaluated by querying the dedicated IF field of a NM structured reporting database (Vericis, Merge Healthcare, Chicago, IL). All IF were evaluated by ABR certified readers. Only significant findings as determined by the interpreting radiologist were placed into the field. IF were categorized into those seen on the emission scan and those seen on CT.

#### RESULTS

IF were discovered on 370 (3.5%) of studies. Of these, 9 (0.08%) were noted on the emission scan, while 362 (3.4%) were noted on the CT. The rate on Sestamibi SPECT/CT was 166/9446 (1.7%) while the rate on Rb-82 PET was 204/1074 (19.0%).

#### **CONCLUSION**

IF considered significant by the interpreting radiologist are more prevalent in our practice than previously reported especially when CT quality approaches diagnostic quality as with PET/CT. On hybrid imaging, they are more common on the CT portion of the study than on the emission scan. This underscores the recommendation for reporting these findings and argues for having physicians familiar with conventional CT imaging interpret the CT portion of hybrid imaging studies.

#### **CLINICAL RELEVANCE/APPLICATION**

The majority of IF at hybrid cardiac imaging appear on CT, arguing for having interpreters experienced in conventional CT review the CT portion of the study.

SSQ11

## ISP: Informatics (Quality and Safety)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S403A



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

**FDA** Discussions may include off-label uses.

### Participants

Woojin Kim, MD, Philadelphia, PA (*Moderator*) Co-founder, Montage Healthcare Solutions, Inc; Shareholder, Montage Healthcare Solutions, Inc; Board of Directors, Montage Healthcare Solutions, Inc; Advisory Board, Zebra Medical Vision Ltd  
Kevin W. McEnery, MD, Houston, TX (*Moderator*) Advisor, Koninklijke Philips NV  
Kevin L. Junck, PhD, Birmingham, AL (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ11-01 Informatics Keynote Speaker: Role of Informatics in Quality

Thursday, Dec. 3 10:30AM - 10:40AM Location: S403A

### Participants

Woojin Kim, MD, Philadelphia, PA (*Presenter*) Co-founder, Montage Healthcare Solutions, Inc; Shareholder, Montage Healthcare Solutions, Inc; Board of Directors, Montage Healthcare Solutions, Inc; Advisory Board, Zebra Medical Vision Ltd

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Woojin Kim, MD - 2012 Honored Educator

#### SSQ11-02 How I Missed Your Cancer? An Eye-Tracking Study of Radiological Error in the Detection of Lung Nodules

Thursday, Dec. 3 10:40AM - 10:50AM Location: S403A

### Participants

Gregory DiGirolamo, PhD, Worcester, MA (*Abstract Co-Author*) Nothing to Disclose  
Zachary Zaniewski, Worcester, MA (*Presenter*) Nothing to Disclose  
Max P. Rosen, MD, MPH, Worcester, MA (*Abstract Co-Author*) Stockholder, Everest Scientific Inc; Consultant, PAREXEL International Corporation; Stockholder, Cynvenio Biosystems, Inc; Medical Advisory Board, Cynvenio Biosystems, Inc

### PURPOSE

Radiologists may miss findings on ~30% cases. These misdiagnoses can result from visual or cognitive/decision-making errors. Visual errors may include: Scanning errors-not visually fixating on the region that contains an abnormality. Cognitive/Decision errors include: Decision errors-visually fixating on an abnormality, but declaring it normal, and/or Recognition errors- visually fixating on the region of an abnormality, but not identifying it. We investigated conscious recognition errors and whether Radiologists might have unconscious detection of lung nodules despite no conscious recognition.

### METHOD AND MATERIALS

6 experienced Radiologists interpreted 18 axial chest CT scans (9 normal and 9 abnormal), each consisting of 200-400 slices. There were 16 lung nodules in total across the 9 abnormal CT scans. The presence and location of lung nodules were identified by a mouse click. Using an Eye-Link 1000, we tracked the location and duration of eye fixations using an invisible (to the observer) grid on each image. Error rates were calculated as our main index of accuracy, and duration of eye movements in each grid region were used to determine if there was unconscious detection of a lung nodule.

### RESULTS

On average, 8/16 (50%, +/- 9%) lung nodules were consciously identified, and registered by a mouse click. However, even when no conscious detection of the lung nodule was registered, Radiologists made significantly longer fixations to the grid regions where the lung nodules were located, ( $p < .007$ ). Radiologists fixated longer in the grid region where a nodule was located when compared to any other region in that same image ( $p < .02$ ), even when the nodule was not consciously detected. Radiologists also fixated longer in the grid region where a lung nodule was present (even when not consciously detected) than any grid region in a normal image,  $p < .03$ .

### CONCLUSION

Our data suggest that even when not consciously recognized, experienced radiologists unconsciously detect the location of lung nodules.

### CLINICAL RELEVANCE/APPLICATION

Many findings missed in clinical practice, may actually be detected unconsciously. The use of eye-tracking, or other technologies may improve Radiologists' performance.

#### SSQ11-03 Scanning Clinical Security Worldwide: Maps and Country Ratings

Thursday, Dec. 3 10:50AM - 11:00AM Location: S403A

#### Participants

Oleg S. Pianykh, Newton Highlands, MA (*Presenter*) Nothing to Disclose

#### Background

The fundamental standards of digital medical data exchange, such as DICOM and HL7, date back to the late 1980s. And although these standards went through countless enhancements, one particular aspect - security - remained virtually untouched. The main purpose of our work was to perform the first comprehensive study of clinical security worldwide.

#### Evaluation

We used DICOM and HL7 association establishment protocols to develop a fast, parallel-processing security-probing application. Testing each IP address for its openness to transmit medical data (with no actual data transferred), the application scanned the entire worldwide space of IP addresses in 3 weeks. Geolocation services were used to map each insecure IP we identified. As a result, we compiled a comprehensive map of open clinical servers worldwide, with different levels of security threats.

#### Discussion

Our scan discovered 2774 DICOM servers worldwide, out of which 719 were open for medical data communications. HL7 results were similar. Each protocol was used to categorize our findings by different levels of security threats, and geolocation data - by countries and regions. As a result, we compiled clinical security ratings per country, per capita, and per IT infrastructure. We also built the first map of DICOM/HL7 adoption worldwide

#### Conclusion

Medical data archives, left wide-open to security threats, is by far the most common security problem, which needs to be addressed with a robust, standardized, and fully implemented solution. Our results demonstrate the full scope of this problem, and the areas where it needs to be solved first.

### **SSQ11-04 Institution Certification System for Low-Dose Lung Cancer CT Screening in Japan: Development of a New Web-based Image Evaluation Function**

Thursday, Dec. 3 11:00AM - 11:10AM Location: S403A

#### Participants

Rikuta Ishigaki, PhD, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose

Yoshihisa Muramatsu, PhD, Kashiwa, Japan (*Presenter*) Nothing to Disclose

Yuichiro Maruyama, MD, PhD, Komoro, Japan (*Abstract Co-Author*) Nothing to Disclose

Isao Yamaguchi, PhD, RT, Sakai, Japan (*Abstract Co-Author*) Nothing to Disclose

Michael F. McNitt-Gray, PhD, Los Angeles, CA (*Abstract Co-Author*) Institutional research agreement, Siemens AG; Research support, Siemens AG; ; ; ;

Yoshito Tabata, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose

Masato Mori, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose

Masafumi Shinozaki, RT, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose

Kouzou Hanai, PhD, RT, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose

#### Background

In Japan, an institution certification system is being established by the Accreditation Council for Lung Cancer CT Screening. Given progress in database systems with a dose index registry (DIR) function known as the combined application dose index (CADI), the CADI system will be used to evaluate both dose and image quality. A special image evaluation function has been developed for this new use.

#### Evaluation

The CADI system consists of a CADI server and clients. Image data and dose information are compiled in DICOM and IHE-REM databases. Web-based access to the CADI server is possible from approved CADI clients, permitting image evaluation for lung cancer CT screening. This system was certified as meeting the IHE REM Profile at the NA Connectathon 2013, and the web-based access is WADO compliant. A demonstration study was conducted between January 5 and March 31, 2015. A chest phantom containing simulated lesions (LSCT-001, Kyoto Kagaku) was scanned using the CT screening protocols at each institution (16 institutions, 22 CT systems). CT images (as a 5 mm-slice and a 1 mm interval) and dose reports were sent to CADI clients and transferred to the CADI server, and dose information and image interpretation by certified radiologists were analyzed. The calculated CTD<sub>ivol</sub> values were 1.9±0.8 mGy (mean ± SD). The calculated DLP values were 65.1±26.7 mGy (mean ± SD). The submitted phantom images are reviewed for image quality and the detectability of the simulated lesions is assessed. The average detected diameter (mean ± SD) was 8.9±0.8 mm for the right lung (Design contrast = 100 HU) and 5.7±0.4 mm for the left lung (Design contrast = 270 HU).

#### Discussion

It is essential to ensure the appropriate image quality at reduced dose for CT screening in healthy people. Dose and image quality evaluations were performed from the CADI client on Web, and statistical analyses were performed. This allows standardization of CT screening across Japan; Institutions certified by the Accreditation Council will be able to provide reliable CT screening services.

#### Conclusion

We have developed a new web-based image evaluation function for the CADI system to establish an institution certification system for lung cancer CT screening.

## **SSQ11-05 Conventional X-ray Dose Analysis in Pediatrics Patients in Different Hospitals Using a Centralized Electronic Platform**

Thursday, Dec. 3 11:10AM - 11:20AM Location: S403A

### **Participants**

Eduardo Fraile Moreno, MD, PhD, San Sebastian de Los Reyes, Spain (*Presenter*) Nothing to Disclose  
Carlos Benito, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
Jose Carmelo Albillos, Alcorcon, Spain (*Abstract Co-Author*) Nothing to Disclose  
Patricia Fraga Rivas, MD, Coslada, Spain (*Abstract Co-Author*) Nothing to Disclose  
Esther Dominguez-Franjo, MD, PhD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
Josefa Galobardes Monge, MD, Parla, Spain (*Abstract Co-Author*) Nothing to Disclose  
Trinidad Villarejo, Parla, Spain (*Abstract Co-Author*) Nothing to Disclose

### **Background**

Imaging diagnostics studies using Xray modalities are increasing the impact on cumulative dose of irradiation delivered to patients. At the same time, a new legislation (2013/59/Euratom) will be put in place to register dose patient history on his Electronic Health Record. Dose is a concern for everybody in healthcare environment and especially sensitive when we speak about dose delivered to kids. Our objective is to analyze variability on the dose in non-focused pediatric departments and determine root causes to fix them.

### **Evaluation**

The analysis for pediatric segment has been done in 6 hospitals connected in the same network. The studies have been performed in Emergency departments with the same manufacturer and model of digital Xray equipments and same configuration. Data are stored on real time from modalities to a central server used to analyze them. Data from patient studies were collected over a period of one month. They were classified according to patient age (0-1 year; 1-5 years; 5-10 years and 10-15 years) and gender. For each category of patient, the most used protocols were evaluated and their associated dose levels were collected. For each protocol, an alert threshold was calculated based on the usual clinical practice (2 times the percentile median). The root causes were classified (bad patient positioning, bad collimation on patient, pediatric study protocol not selected, bad protocol selected depending on morphology) and measured.

### **Discussion**

This analysis demonstrates that 15.28% of the extra dose applied to pediatric population is caused directly by misunderstanding or lack of knowledge of how to handle this type of patients. Most of these mistakes can be fixed by dose education through Change Acceleration Process (CAP) to take in account seriously the pediatric segment in radiology studies and specific trainings to remind Xray technology basis. Consciousness will be done with explanations of dose effect on kids (stochastic and deterministic effects).

### **Conclusion**

Dose monitoring electronic solution allows us to reduce the variability on the dose in non-focused pediatric departments and determine root causes to fix them.

## **SSQ11-06 Biometric Patient Identity Verification during Magnetic Resonance Imaging of the Brain Using Multi-planar Reconstruction Scout Image**

Thursday, Dec. 3 11:20AM - 11:30AM Location: S403A

### **Participants**

Yasuyuki Ueda, Fukuoka, Japan (*Presenter*) Nothing to Disclose  
Junji Morishita, PhD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose  
Shohei Kudomi, Ube, Japan (*Abstract Co-Author*) Nothing to Disclose  
Katsuhiko Ueda, BS, Ube, Japan (*Abstract Co-Author*) Nothing to Disclose

### **PURPOSE**

Patient misidentification error management is one of the important factors of patient safety. We studied the use of magnetic resonance (MR) images for the purpose of biometric patient identity verification, and show the accuracy of verification performance for clinical use.

### **METHOD AND MATERIALS**

Anatomy-related multi-planar reconstruction (MPR) images, including posterior surface of brainstem and the internal auditory canal (IAC), generated from one three-dimensional fast scout scan of each MR examination were used as biological-fingerprint images in this study. We calculated a correlation value as a similarity score between current and prior biological-fingerprint images. This procedure consists of three major steps, i.e., biological feature extraction, normalization, and calculation of correlation value. In order to evaluate the verification performance, we calculated a false rejection rate (FRR), a false acceptance rate (FAR) and a half-total error rate (HTER) by the discriminant analysis utilizing the squared Mahalanobis distance to declare the patient as genuine or an impostor. Moreover, to evaluate overall performance delivered from a receiver operating characteristic (ROC) curve, the area under the ROC curve (AUC), and the equal error rate (EER) were calculated.

### **RESULTS**

The database of this study consisted of 730 temporal pairs of MR examination of the brain. Many patients of this study have the following disorders: brain tumor and cerebrovascular angiopathy, and 168 patients have undergone surgical operation of the brain before the current examination. Our results indicated a high performance in verifying patients. Our method gave an HTER of 1.59% with an FAR of 0.023% (62/266,085), and an FRR of 3.15% (23/730). The AUC and EER were achieved at 0.998 and 1.37%, respectively.

### **CONCLUSION**

Our method makes it possible to verify the identity of the patient only using some existing medical images without the addition of incidental equipment. We expect our method to be a key solution to patient misidentification problems.

## CLINICAL RELEVANCE/APPLICATION

Our method is useful when we have no other way of confirming whether the registered patient information is correct or not and will contribute to patient misidentification error management caused by human errors.

### SSQ11-07 CT Dose Monitoring and Management System Based on Open-source Software Resources and In-House Development

Thursday, Dec. 3 11:30AM - 11:40AM Location: S403A

#### Participants

Da Zhang, PhD, Boston, MA (*Presenter*) Nothing to Disclose  
Larry Barbaras, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Matthew R. Palmer, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The monitoring and management of radiation dose have become crucial requirements of modern radiology departments. Powerful open-source DICOM utilities could facilitate the implementation of professional-grade systems for collecting CT radiation dose data. However, the heterogeneity of dose data and inconsistent implementations of the DICOM SR standard among different CT models and vendors require additional customization and programming. We present the development, unique features, and clinical applicability of a CT dose tracking system based on freely-available software resources.

#### METHOD AND MATERIALS

Radiation dose structured reports (RDSR) are auto-transmitted from the CT scanners to a Conquest DICOM server. The server spawns two external processes: 1) 'dcm2xml' (from DCMTK) translates RDSR into XML; 2) a PowerShell script mines the XML data and populates database tables. Dose dashboards on the server provide query and display functionality for individual CT exams, while a data dump service provides massive output of dose records for periodic dose analysis and protocol management. Also, a web service that receives real-time queries from the dictation system returns customized dose strings for automatic inclusion in the radiologic reports. For protocol review, dose entries in the dumped data are cleaned and validated. Heterogeneous protocol identifiers are normalized and re-mapped to core protocol names, using a regular expression based method. Similar protocol names are grouped together for per-scanner analysis and cross-scanner comparison. The core protocols that comprise the majority of exams were identified, and summary data were prepared for visual analysis.

#### RESULTS

Over 5000 CT dose records per month have been collected from ten CT scanners (of 7 models and 3 vendors) distributed in three practice sites. Non-trivial inconsistencies in the adoption of RDSR capabilities, especially in the handling of protocol names, were observed. Comparison of dose performance across scanners and against national data was used to trigger root-cause analysis and protocol review.

#### CONCLUSION

Using open-source software resources and in-house expertise, a highly functional and customizable dose monitoring and management system can be developed with limited expense and effort.

## CLINICAL RELEVANCE/APPLICATION

The developed dose tracking and reporting system could greatly facilitate the tasks of CT dose monitoring and management.

### SSQ11-08 Implementation of a Virtual 'Learning from Discrepancy' Meeting: A Method to Improve Radiologist Attendance and Facilitate Shared Learning from Radiological Error

Thursday, Dec. 3 11:40AM - 11:50AM Location: S403A

#### Participants

Anoma Lalani Carlton Jones, MBBS, FRCR, London, United Kingdom (*Presenter*) Nothing to Disclose  
Mary E. Roddie, MD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To assess the effect on radiologist participation in learning from discrepancy meetings (LDMs) in a large radiology department spread across three hospital sites by establishing virtual LDMs using OsiriX (Pixmeo).

#### METHOD AND MATERIALS

Submitted radiological discrepancy cases were added to an OsiriX database after anonymisation with clinical information available at the time and any relevant previous imaging. Prepared cases were loaded onto iMacs in the radiology reporting rooms on each site. For each virtual LDM radiologists were given a 3-week period to review cases either on their own or in groups and send their feedback to the LDM convenor. The learning points and consensus feedback were attached to each case before it was added to a permanent LDM library on the iMacs. Attendance was recorded and compared with that from the previous 4 years of conventional meetings. We obtained radiologist feedback comparing the two types of LDM using an anonymous online questionnaire sent out after the first year of virtual LDMs.

#### RESULTS

Numbers of radiologists attending increased significantly from a mean of  $12.5 \pm 3.1$  for the conventional LDM to  $27.3 \pm 6.2$  for the virtual LDM ( $p < 0.0001$ ) and the percentage of radiologists achieving the UK standard of participation in at least 50% of LDMs per year (the UK standard) rose from an average of 18% to 68%. The number of cases submitted per meeting rose significantly from an average of  $11.1 \pm 2.9$  for conventional LDMs to  $15.2 \pm 6.2$  for virtual LDMs ( $p < 0.02$ ). Analysis of 30 returned questionnaires showed that radiologists welcomed being able to review cases at a time and place of their choosing and at their own pace. They reported that were able to give more honest feedback in the absence of peer pressure. Many felt that the LDM library was a useful educational resource and had changed their clinical practice by highlighting frequently occurring errors.

#### CONCLUSION

Replacement of conventional LDMs rotating between hospital sites in a large radiology department by virtual LDMs improved radiologist participation in the process of group learning from radiological discrepancy and increased the number of submitted cases.

#### **CLINICAL RELEVANCE/APPLICATION**

Introduction of a virtual 'learning from discrepancy' meeting (LDM) and an LDM library can increase radiologist participation in the process of learning from discrepancy and increase the number of cases submitted.

#### **SSQ11-09 Does Dose Awareness Increase after Implementation of a Dose Monitoring Software in Computed Tomography**

Thursday, Dec. 3 11:50AM - 12:00PM Location: S403A

#### **Participants**

Christina Heilmaier, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

Niklaus Zuber, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose

Dominik Weishaupt, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

Dose monitoring becomes more and more important and is an important part of quality control. We wanted to examine whether dose awareness of medical staff increased after a dose monitoring software was installed and implemented in clinical routine.

#### **METHOD AND MATERIALS**

Dose data of two computed tomography scanners was collected from April 2014 to February 2015. We used a dose management software to separately analyze data from April to June 2014 (period 1) and July 2014 to February 2015 (period 2). Starting July 2014 radiographers were instructed look for and answer alarms ('alerts') when dose exceeded predefined thresholds. Chi-square tests were applied to check for statistical significant changes in number and reasons for alerts between both periods. Thresholds were set as 75th-percentile of the distribution of dose length product (DLP, Gy\*cm).

#### **RESULTS**

A total of 13,217 scans were conducted (period 1, n=4,943; period 2, n=8883) and dose data was successfully transferred to the software in all cases. A total of 609 alerts occurred (period 1, n=293; period 2, n=316), mean alert quota 5%. Comparison of both periods showed a significant decrease of mean alert quota in period 2 (4%; period 1, 6%; p<0.001). Decline was mainly caused by a reduced number of notifications due to patient off-centering (period 1, n=129; period 2, n=77; p<0.001), which means patient was not positioned properly in the isocenter of the scanner. Relative number of high body weight alerts (BMI≥25 kg/m<sup>2</sup>) grew in period 2 (51%, n=160; period 1, 36%, n=106), but difference was not statistical significant (p=0.159). All other alert causes were comparable in both periods (p>0.05): scan repetition due to severe motion artifacts (period 1, n=32, 11%; period 1, n=36, 11%), osteosynthesis material (OSM) in scanning area and leading to dose up-regulation (period 1, n=24, 8%; period 2, n=28, 9%) and others such as imaging on spine-board (period 1, n=3, 1%; period 2, n=15, 5%).

#### **CONCLUSION**

A dose monitoring software can be successfully implemented in clinical routine and increases dose awareness in medical staff, thereby leading to a reduction of the number of dose alerts due to human error.

#### **CLINICAL RELEVANCE/APPLICATION**

Implementation of a dose monitoring software in clinical routine can be successfully accomplished and is an important tool for increasing dose awareness in medical staff, thereby improving quality assurance and patient safety.

MSES52

## Essentials of Trauma Imaging

Thursday, Dec. 3 10:30AM - 12:00PM Location: S406B

**CH** **MK** **NR** **ER**

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

### Participants

#### Sub-Events

#### **MSES52A Cervical Spine Trauma**

#### Participants

Peter J. MacMahon, MD, Dublin, Ireland, (pmacmahon@mater.ie) (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Identify the stabilizing anatomical structures of the cervical spine. 2) Appraise the indications for the various cervical spine imaging modalities. 3) Classify cervical spinal injuries based on the mechanism of injury and stability. 4) Differentiate the most common cervical spine injuries. 5) Detect subtle soft tissue and bony injuries of the cervical spine.

#### **MSES52B A Simplified Approach to Imaging Acetabular Fractures**

#### Participants

Ustun Aydingoz, MD, Ankara, Turkey, (ustunaydingoz@yahoo.com) (*Presenter*) Speaker, AbbVie Inc; Spouse, Stockholder, Edita Medical Writing Editing Ltd; Spouse, Employee, Edita Medical Writing Editing Ltd;

#### LEARNING OBJECTIVES

1) Identify the imaginary lines on radiographs to determine the presence of an acetabular fracture. 2) List five most common acetabular fractures that comprise approximately 90% of all. 3) Apply an algorithm to detect the five most common acetabular fractures on radiographs and/or CT. 4) Explain the most relevant information for the clinician regarding imaging assessment of acetabular fractures.

#### ABSTRACT

Imaging plays an indispensable role in detecting and classifying acetabular fractures. This live activity will focus on: A) identifying acetabular fractures on radiographs and CT, B) using an algorithm to classify the five most common acetabular fractures (that comprise approximately 90% of all), and C) mentioning clinically relevant points on imaging reports to help decision-making for better management of the patient's condition.

#### Handout:Ustun Aydingoz

[http://abstract.rsna.org/uploads/2015/15001876/RSNA2015\\_MSES52B\\_Acetabular fx.pdf](http://abstract.rsna.org/uploads/2015/15001876/RSNA2015_MSES52B_Acetabular fx.pdf)

#### **MSES52C Blunt Trauma of Lung, Pleura, Airways, and Chest Wall**

#### Participants

Guillermo P. Sangster, MD, Shreveport, LA, (gsangs@lsuhsc.edu) (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Substantiate the advantages of multidetector computed tomography (MDCT) over Chest x-ray for the initial screening of chest trauma. 2) Identify the MDCT imaging findings of the non-vascular traumatic thoracic injuries.

#### ABSTRACT

Chest radiography has been the traditional screening technique to evaluate traumatic thoracic injuries. The information obtained is usually sub optimal for the diagnosis of non-vascular thoracic injuries. The benefits of MDCT for its diagnosis are discussed in this live activity. Images from our level I trauma center database are shown, including: A) Thoracic wall injuries: diaphragmatic rupture, sternum and scapular fractures, sterno-clavicular dislocation and flail chest. B) Pleuro-pulmonary injuries: contusion, laceration, herniation, pneumothorax, and hemothorax. C) Intrathoracic traqueo-bronchial laceration.



MSRT54

## ASRT@RSNA 2015: Renal and Urographic CT Imaging

Thursday, Dec. 3 11:45AM - 12:45PM Location: N230



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

### Participants

Robert C. Chatelain, RT, Ottawa, ON (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To identify normal anatomy and its variants demonstrated by CT of the urinary system. 2) To explain the value of having specific dedicated protocols for the renal and urographic imaging. 3) To differentiate renal and urographic pathologies by origin (congenital, neoplastic, vascular etc.)

### ABSTRACT

The urinary system is subject to a wide variety of pathological processes and anatomical variants. Fortunately, it lends itself well to being imaged by a range of modalities. This presentation will focus on the imaging of the urinary system using Computed Tomography (CT). Due to high spatial resolution, CT is an excellent tool to evaluate stones, masses, traumatic injuries and infections. Non contrast CT is the procedure of choice to evaluate kidney stones. CT is also used to differentiate malignant from nonmalignant renal masses, to evaluate the local spread of a renal malignancy and CT angiography (CTA) is an excellent tool to define the anatomy of the renal arteries and veins.

RCA53

## National Library of Medicine: Find Articles You Need: Searching PubMed/MEDLINE Efficiently (Hands-on)

Thursday, Dec. 3 12:30PM - 2:00PM Location: S401AB

**IN**

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

### Participants

Marilia Y. Antunez, MA, Fredonia, NY (*Presenter*) Nothing to Disclose

Holly Ann Burt, MLIS, Chicago, IL (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand how PubMed constructs a query and how to develop and refine effective search strategies in radiology. 2) Use PubMed tools including Clinical Queries, Related Articles, Single Citation Matcher and Loansome Doc. 3) Build focused searches using the Medical Subject Headings (MeSH) vocabulary for radiology and limit searches to radiology-oriented journals. 4) Understand how to save and download citations.

### ABSTRACT

This hands-on workshop covers key searching techniques, changes to PubMed, and how to develop effective search strategies for PubMed and MEDLINE. Topics covered include: why keywords don't always give the results you expect, how to limit to specific journals, quick searches to find evidence-based citations, how to access full-text articles, and downloading citations to reference manager programs. The National Library of Medicine (NLM) provides free web access to nearly 24 million citations for biomedical and clinical medical articles through PubMed (available online at PubMed.gov). MEDLINE is a subset of PubMed which includes links to sites providing full text articles and to other related databases and resources.

### URL

**Handout:** Holly Ann Burt

<http://abstract.rsna.org/uploads/2015/14003436/2015pubmedRSNA.pdf>

## Next Generation Infrastructure for Medical Imaging (In Association with the Society for Imaging Informatics in Medicine)

Thursday, Dec. 3 12:30PM - 2:00PM Location: S501ABC



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

### Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Moderator*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Medical Advisory Board, Merge Healthcare Incorporated

### LEARNING OBJECTIVES

1) The participant will be introduced to the importance of information system integration and interoperability to support modern imaging informatics workflow. 2) Examples of practical integration strategies that have been used successfully (e.g. web viewer EHR integration, single sign-on, RIS vs PACS driven workflow) will be discussed. 3) Advanced integration strategies, including using vendor APIs, state aggregation, SOA, and IHE, will be presented.

### ABSTRACT

Modern imaging informatics workflow requires consumption, choreography, and orchestration of content from multiple disparate information systems that do not natively "talk to each other." Without optimal integration and interoperability amongst these systems, humans are required to serve as "integrating agents:" this frequently results in inefficiency and error. This session will provide an introduction to the importance of system integration and will provide a practical introduction to commonly used integration strategies. In addition, more advanced integration approaches, including leveraging vendor APIs (application programming interfaces), IHE, and SOA (service oriented architecture) will be discussed.

### Sub-Events

#### RCC53A Interoperability and Integration-from HL7, DICOM, IHE, to SOA

### Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Medical Advisory Board, Merge Healthcare Incorporated

### LEARNING OBJECTIVES

1) The participant will be introduced to the importance of information system integration and interoperability to support modern radiology workflow. 2) Examples of practical integration strategies that have been used successfully (e.g. web viewer EHR integration, single sign-on, RIS vs PACS driven workflow) will be discussed. 3) Advanced integration strategies, including using vendor APIs, state aggregation, SOA, and IHE, will be presented.

### ABSTRACT

Modern radiology workflow requires consumption, choreography, and orchestration of content from multiple disparate information systems that do not natively "talk to each other." Without optimal integration and interoperability amongst these systems, humans are required to serve as "integrating agents:" this frequently results in inefficiency and error. This session will provide an introduction to the importance of system integration and will provide a practical introduction to commonly used integration strategies. In addition, more advanced integration approaches, including leveraging vendor APIs (application programming interfaces), IHE, and SOA (service oriented architecture) will be discussed.

#### RCC53B Image Sharing-A Fond Farewell to CDs

### Participants

David S. Mendelson, MD, Larchmont, NY (*Presenter*) Spouse, Employee, Novartis AG; Advisory Board, Nuance Communications, Inc; Advisory Board, General Electric Company; Advisory Board, Toshiba Corporation

### LEARNING OBJECTIVES

1) Understand the importance of Image Sharing / Exchange with regard to the quality of care a radiologist delivers as well as to efforts to control costs. 2) Understand the benefits and pitfalls of CDs and the transition to internet based sharing. 3) Understand the different internet (Cloud) based solutions that are available and what distinguishes them. 4) Learn that the cloud can be employed not only for archival but for a variety of radiology services. 5) Learn about the IHE XDS-I and related profiles and their role in internet based image exchange. 6) Understand what solutions a radiologist might implement at this time. 7) Understand how image exchange fits into the broader efforts directed at healthcare information exchange and interoperability through EHRs.

### ABSTRACT

The safe and secure exchange of healthcare information is of paramount importance in delivering the highest quality of care to our patients. The realm of Health Information Exchange while nascent is undergoing explosive growth. The exchange of radiologic exams and reports must be tightly integrated into this process. Radiological images have historically presented some unique challenges. This session will focus on existing solutions for image exchange/interoperability and discuss how it is expected to evolve over the next few years through the use of internet based technologies.

#### RCC53C Vendor Neutral Archives vs Archive Neutral Vendors: Towards the Next Generation Archive

### Participants

Richard L. Kennedy, MSc, Sacramento, CA (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the differences between vendor neutral archives, archive neutral vendors, and cloud archives. 2) Identify key strategic advantages and disadvantages of these three respective models of archival. 3) Observe some potential obstacles to implementation of these three respective models of archival.

VSIO51

## Interventional Oncology Series: Management of Hepatic Metastases from Colorectal Cancer and Neuroendocrine Tumors

Thursday, Dec. 3 1:30PM - 6:00PM Location: S405AB



AMA PRA Category 1 Credits™: 4.25  
ARRT Category A+ Credits: 5.00

**FDA** Discussions may include off-label uses.

### Participants

Sarah B. White, MD,MS, Philadelphia, PA, (sbwhite@mcw.edu) (*Moderator*) Nothing to Disclose

### ABSTRACT

#### Sub-Events

#### VSIO51-01 Setting the Stage: NCCN/ESMO Guidelines for mCRC

Thursday, Dec. 3 1:30PM - 1:45PM Location: S405AB

#### Participants

Mary F. Mulcahy, MD, Chicago, IL (*Presenter*) Nothing to Disclose

#### VSIO51-02 Advances in the Surgical Toolbox for Colorectal Liver Metastases

Thursday, Dec. 3 1:45PM - 2:00PM Location: S405AB

#### Participants

Kiran Turaga, Milwaukee, WI (*Presenter*) Speakers Bureau, Caris Life Sciences; Consultant, Johnson & Johnson

### LEARNING OBJECTIVES

1) To identify the role and timing of surgical resection of metastatic colorectal cancer in improving survival of patients. 2) To identify potential pitfalls and risks in implementing surgical resection with regional therapies to the liver. 3) To understand the evolving role of hepatic arterial infusional therapy in the management of patients with unresectable CRLM.

#### VSIO51-03 Colorectal Liver Metastases: To Ablate or not to Ablate?

Thursday, Dec. 3 2:00PM - 2:15PM Location: S405AB

#### Participants

David A. Woodrum, MD, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To understand the role of ablation for colorectal metastases. 2) To identify which patients may be the best candidates for ablation. 3) To review the advantages/disadvantages of the liver ablation technologies.

### ABSTRACT

Colorectal cancer is ranked fourth in cancer occurrence and second in cancer death in the West. Somewhere between 50-70% of these patients will develop liver metastases throughout their course. Locoregional thermal ablative therapies are important treatment options for liver metastases, achieving good short-term outcomes with low morbidity. This review summarizes the current evidence for the using liver ablation techniques with colorectal metastases and summarizes which patient population may benefit the most.

#### VSIO51-04 K-ras Mutation is Associated with a Shorter Overall Survival after RF Ablation of Colorectal Liver Metastases

Thursday, Dec. 3 2:15PM - 2:25PM Location: S405AB

#### Participants

Waleed Shady, MBBCh, New York, NY (*Presenter*) Nothing to Disclose

Vlasios S. Sotirchos, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Elena N. Petre, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Etay Ziv, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Jeremy C. Durack, MD, New York, NY (*Abstract Co-Author*) Scientific Advisory Board, Adient Medical Inc Investor, Adient Medical Inc

Constantinos T. Sofocleous, MD, PhD, New York, NY (*Abstract Co-Author*) Consultant, Sirtex Medical Ltd

Stephen B. Solomon, MD, New York, NY (*Abstract Co-Author*) Research Grant, General Electric Company

Efsevia Vakiani, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Mithat Gonen, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Rona D. Yaeger, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Nancy Kemeny, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To describe the incidence and patterns of genetic marker mutations, and to evaluate their potential prognostic value on local tumor progression (LTP)-free and overall survival (OS) after RFA of colorectal cancer liver metastases (CLM).

## METHOD AND MATERIALS

We performed an IRB approved retrospective review of a HIPPA compliant clinical ablation database for patients with CLM treated with RFA between December 2002 and December 2012. Only patients with available genetic testing profiles were included. Genetic profiles were obtained by mass-spectrometry based sequenom assay of surgical/biopsy specimens obtained from primary/metastatic sites. Genes analyzed for mutations included: (1) K-ras, (2) K-ras and BRAF, or (3) an 8 gene panel (K-ras, N-ras, BRAF, PIK3CA, Akt1, MEK1, ERBB2, and EGFR). Kaplan-Meier methodology was used to calculate LTP-free and OS rates. The log-rank test was used to evaluate the prognostic value of genetic marker mutations.

## RESULTS

This study enrolled 90 patients with 139 CLM. Median tumor size was 1.7 cm (range: 0.6-5 cm). The median follow-up was 52 months. Results for the mutation status were available for k-ras in all patients, for BRAF in 58 patients, and for the 8 genes in 23 patients. K-ras was mutated in 40% of patients (36/90), BRAF in 7% (4/58), PIK3CA in 17% (4/23), N-ras in 9% (2/23), and no mutations were observed for the other genes. There was a trend towards shorter median OS in patients with mutated genes; K-ras (29 months versus 46 months), BRAF (22 months versus 53 months), PIK3CA (22 months versus 51 months), N-ras (8 months versus 51 months). Statistical significance was only reached for K-ras ( $P=0.037$ ) and N-ras ( $P<0.001$ ), but not for BRAF ( $P=0.18$ ) and PIK3CA ( $P=0.8$ ). There was no difference in the LTP-rates with mutations of K-ras 46% (22/48) versus 42% (38/90) ( $P=0.26$ ), BRAF 33% (2/6) versus 39% (43/88) ( $P=0.69$ ), PIK3CA 0% (0/5) versus 39% (15/38) ( $P=0.16$ ), or N-ras 50% (1/2) versus 34% (14/41) ( $P=0.17$ ). There was a trend towards shorter LTP-free survival with K-ras mutations; median of 26 months versus 37 months.

## CONCLUSION

Mutations of K-ras and N-ras are associated with a shorter overall survival after RFA of CLM. Mutations of K-ras are associated with a shorter LTP-free survival, although LTP rate was not statistically different.

## CLINICAL RELEVANCE/APPLICATION

K-ras mutant patients require more strict follow-up and could benefit from adjuvant chemotherapy after RFA of CLM.

## VSI051-05 Palliative Embolotherapy: New Technology, New Promises?

Thursday, Dec. 3 2:25PM - 2:40PM Location: S405AB

### Participants

Tobias F. Jakobs, MD, Munich, Germany, (tobias.jakobs@barmherzige-muenchen.de) (*Presenter*) Speaker, Sirtex Medical Ltd; Research Consultant, Sirtex Medical Ltd; Speaker, Siemens AG; Speaker, Terumo Corporation; Speaker, Surefire Medical, Inc; Speaker, BTG International Ltd

## LEARNING OBJECTIVES

1) Indications for palliative embolotherapy. 2) Results of palliative embolization in mCRC patients. 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 mCRC patients, together with the associated complications and future options.

## VSI051-06 A Gene Signature to Predict Tumor Response to Hepatic Arterial Embolization

Thursday, Dec. 3 2:40PM - 2:50PM Location: S405AB

### Participants

Etay Ziv, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose  
Elena N. Petre, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Stephen B. Solomon, MD, New York, NY (*Abstract Co-Author*) Research Grant, General Electric Company  
Franz E. Boas, MD, PhD, New York, NY (*Abstract Co-Author*) Co-founder, ClariPACS  
Karen T. Brown, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Joseph P. Erinjeri, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To identify a gene mutation signature that may potentially be used to predict tumor response to hepatic arterial embolization.

## METHOD AND MATERIALS

We performed a retrospective review to identify patients who have undergone bland hepatic arterial embolization for the treatment of primary liver cancer or liver metastases that also had available a panel of genetic testing results--specifically, an assay that identifies mutations in any of 341 'druggable' genes by sequencing tumor samples and comparing with germline mutations. A total of 10 patients were identified whose biopsy specimens were recovered either prior to or after embolization of the liver tumors. Of the ten patients identified, 4 had hepatocellular carcinoma (HCC), and the other 6 had non-HCC tumors included pancreatic neuroendocrine tumor (2), melanoma (1), thyroid (1), kidney carcinoid (1), and acinar cell tumor (1). We used principal component analysis for dimensionality reduction and to identify the genes which most contributed to the variance in the data. Patients were categorized using RECIST criteria as either responders (partial response or complete response) or non-responders (progressive disease or stable disease) post-embolization.

## RESULTS

Of the ten patients identified, half demonstrated either complete response or partial response post-embolization (two of these were HCC patients). The rest were categorized as non-responders. A principal component analysis demonstrates that much of the variance in the data can be summarized by the two groups (responders and non-responders), and that the second principal component may predict tumor response to embolization (see Figure 1). The top genes contributing to this principal component are involved in cross-talk between the Wnt/B-catenin signaling pathway and hypoxia signaling pathway (see Table 1).

## CONCLUSION

A gene mutation signature suggests that tumor response to embolization may be predicted by the underlying mutation profile of the tumor and moreover, suggests a central role for the involvement of hypoxia and Wnt/B-catenin signaling pathways.

## CLINICAL RELEVANCE/APPLICATION

A gene signature that can predict tumor response to embolization may be used to better stratify patients as well as potentially broaden the scope of embolization to liver metastases not traditionally treated by this procedure.

## VSI051-07 Delayed-arterial Phase Cone-Beam CT Improves the Visibility of Liver Metastasis during Intra-arterial Therapy

Thursday, Dec. 3 2:50PM - 3:00PM Location: S405AB

### Participants

Ruediger E. Schernthaner, MD, Vienna, Austria (*Presenter*) Nothing to Disclose  
Reham R. Haroun, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose  
Rafael Duran, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Howard Lee, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose  
Sonia P. Sahu, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose  
Jae Ho Sohn, MD,MS, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose  
Julius Chapiro, MD, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose  
Yan Zhao, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Boris Gorodetski, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Florian N. Fleckenstein, MS, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose  
Susanne Smolka, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose  
Ming De Lin, PhD, Cambridge, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV  
Alessandro G. Radaelli, PHD, MS, Best, Netherlands (*Abstract Co-Author*) Employee, Koninklijke Philips NV  
Martijn Van Der Bom, MSC, Andover, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV  
Jean-Francois H. Geschwind, MD, Westport, CT (*Abstract Co-Author*) Researcher, BTG International Ltd; Consultant, BTG International Ltd; Researcher, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Researcher, Guerbet SA; Consultant, Guerbet SA; Consultant, Terumo Corporation; Consultant, Threshold Pharmaceuticals, Inc; Consultant, PreScience Labs, LLC; Researcher, Boston Scientific Corporation; Consultant, Boston Scientific Corporation

## PURPOSE

Improved visibility of liver metastasis during intra-arterial therapy (IAT) could improve tumor targeting. The purpose of this study was to compare the visibility of liver metastasis on dual-phase cone-beam CT (DP-CBCT) and digital subtraction angiography (DSA), with reference to pre-interventional contrast-enhanced magnetic resonance imaging (CE-MRI) of the liver.

## METHOD AND MATERIALS

Of 416 patients with liver metastasis treated with IAT between January 2010 and October 2014 at our institution, 15, 10 and 3 patients with neuroendocrine, colorectal and sarcoma liver metastasis (NELM, CRCLM and SLM), respectively, had intra-procedural DP-CBCT and were included in this retrospective study. DP-CBCT was acquired after a single injection of contrast agent in the tumor-feeding arteries at an early and delayed arterial phases (EAP and DAP). The visibility of each lesion was graded by two radiologists in consensus on a three rank scale (complete, partial and none) on DP-CBCT and DSA images when compared to CE-MRI. McNemar's test was used.

## RESULTS

47 NELM, 45 CRCLM and 16 SLM lesions were included. On DSA, 59.6%, 15.6% and 18.8% of NELM, CRCLM and SLM lesions were completely depicted, respectively. Complete depiction rate on EAP-CBCT was significantly higher for CRCLM (44.4%;  $p < 0.001$ ), but significantly lower for NELM (40.4%;  $p = 0.049$ ) and similar for SLM (25%,  $p = 1.0$ ). On DAP-CBCT however, the highest rates of complete depiction were found - NELM (97.1%), CRCLM (91.1%) and SLM (100%), all  $p < 0.001$ . Complete or partial depiction was achieved on DSA for 85.1%, 42.2% and 37.5% of NELM, CRCLM and SLM, respectively. EAP-CBCT yielded significantly higher sensitivities of 84.4% and 87.5% for CRCLM and SLM, respectively ( $p < 0.02$ ), but not for NELM (89.4%;  $p = 0.625$ ). DAP-CBCT again demonstrated the highest sensitivity at 100%, 95.6% and 100% for NELM, CRCLM and SLM, respectively ( $p < 0.002$ ). In summary, out of 108 metastatic liver lesions, 106 (98.1%) were at least partially depicted and only 2 (1.9%) CRCLM could not be identified on DAP-CBCT. In contrast, 43 (39.8%) lesions could not be identified on DSA.

## CONCLUSION

DAP-CBCT significantly improves the visibility of liver metastasis during IAT and should be used as standard intra-procedural imaging technique.

## CLINICAL RELEVANCE/APPLICATION

Improved visibility of metastatic liver lesions facilitates a more selective treatment to reduce non-target embolization without missing some lesions occult on DSA.

## VSI051-08 mCRC Tumor Board

Thursday, Dec. 3 3:00PM - 3:30PM Location: S405AB

### Participants

Michael C. Soulen, MD, Philadelphia, PA (*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  
Sarah B. White, MD,MS, Philadelphia, PA, (sbwhite@mcw.edu) (*Presenter*) Nothing to Disclose  
Mary F. Mulcahy, MD, Chicago, IL (*Presenter*) Nothing to Disclose  
Kiran Turaga, Milwaukee, WI (*Presenter*) Speakers Bureau, Caris Life Sciences; Consultant, Johnson & Johnson  
David A. Woodrum, MD, PhD, Rochester, MN (*Presenter*) Nothing to Disclose  
Tobias F. Jakobs, MD, Munich, Germany, (tobias.jakobs@barmherzige-muenchen.de) (*Presenter*) Speaker, Sirtex Medical Ltd;

Research Consultant, Sirtex Medical Ltd; Speaker, Siemens AG; Speaker, Terumo Corporation; Speaker, Surefire Medical, Inc; Speaker, BTG International Ltd

## LEARNING OBJECTIVES

### ABSTRACT

#### VSIO51-09 Setting the Stage mNET

Thursday, Dec. 3 3:40PM - 3:55PM Location: S405AB

#### Participants

Emily Bergsland, MD, San Francisco, CA (*Presenter*) Research funding, Novartis AG Research support, F. Hoffmann-La Roche Ltd Consultant, Pfizer Inc Consultant, Lexicon Pharmaceuticals, Inc Consultant, Novartis AG

## LEARNING OBJECTIVES

1) Review the epidemiology and classification of gastroenteropancreatic neuroendocrine tumors (GEPNETS). 2) Discuss the role of somatostatin analogs for the treatment of GEPNETS. 3) Summarize the current systemic treatment options for metastatic GEPNETS. 4) Examine commonly applied treatment algorithms for advanced GEPNETS.

### ABSTRACT

#### VSIO51-10 Aggressive Surgical Management in mNET

Thursday, Dec. 3 3:55PM - 4:10PM Location: S405AB

#### Participants

Robert E. Roses, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1) Discuss the role of liver resection or ablation in the multidisciplinary management of neuroendocrine tumors.

### ABSTRACT

The management of neuroendocrine tumors has evolved considerably in recent years with the introduction of new systemic and local therapies. Surgery remains an important component of therapy. Indications for surgery for primary tumors and metastases as well nuances of therapy sequencing and multidisciplinary decision making will be discussed.

#### VSIO51-11 Imaging Biomarkers of Tumor Response in Neuroendocrine Liver Metastases Treated with Intraarterial Therapy: Can Whole Liver Response Patterns Predict Patient Survival?

Thursday, Dec. 3 4:10PM - 4:20PM Location: S405AB

#### Participants

Sonia P. Sahu, New Haven, CT (*Presenter*) Nothing to Disclose  
Ruediger E. Schemthaner, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Roberto Ardon, Suresnes Cedex, France (*Abstract Co-Author*) Employee, Koninklijke Philips NV  
Julius Chapiro, MD, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose  
Jae Ho Sohn, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Yan Zhao, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Florian N. Fleckenstein, MS, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose  
Ming De Lin, PhD, Cambridge, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV  
Jean-Francois H. Geschwind, MD, Westport, CT (*Abstract Co-Author*) Researcher, BTG International Ltd; Consultant, BTG International Ltd; Researcher, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Researcher, Guerbet SA; Consultant, Guerbet SA; Consultant, Terumo Corporation; Consultant, Threshold Pharmaceuticals, Inc; Consultant, PreScience Labs, LLC; Researcher, Boston Scientific Corporation; Consultant, Boston Scientific Corporation  
Rafael Duran, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Neuroendocrine liver metastases (NELM) usually appear diffuse and bi-lobar. However, conventional therapy response assessments (WHO, RECIST, mRECIST, and EASL) are lesion-based and thus challenging to implement in NELM patients. We propose a new approach that uses 3D liver segmentation to assess the total enhancing tumor volume (ETV). The purpose of this study was to investigate whether changes in ETV on contrast-enhanced T1 weighted MRI could be an early biomarker for survival after the first transarterial chemoembolization (TACE).

## METHOD AND MATERIALS

This retrospective study included 51 patients (men: 28; median age: 58.3 years) with diffuse bi-lobar NELM who underwent MRI 3-6 weeks before and after the first TACE. Using prototype semi-automatic 3D software, two independent readers segmented the whole liver, placed a 1 cm<sup>3</sup> region of interest (ROI) in healthy liver parenchyma, and measured the ETV in the arterial phase. Enhancement was defined as >2 standard deviations the average intensity of the ROI. Intraclass correlation (ICC) assessed inter-reader agreement. Paired t-test compared the ETV before and after TACE. If ETV decreased by ≥ 50%, patients were classified as responders. Survival analysis included Kaplan-Meier curves with the log-rank test and Cox-proportional hazards modeling. Baseline characteristics that were statistically significant on univariate analysis were adjusted for in the multivariate model.

## RESULTS

Mean ETV decreased significantly after TACE from 1432.6 to 826.6 cm<sup>3</sup> (p <0.01) and 20 (39.2%) patients were classified as responders. Responders had a significantly better prognosis than non-responders, with a median overall survival of 84.3 vs. 16.7 months, respectively (p<0.01). In univariate analysis, response was a significant predictor of survival (HR: 0.15, 95% CI: 0.06-0.39) and in the multivariate model adjusted for ECOG ≥1, portal vein thrombosis and extrahepatic disease, response was the only significant covariate (HR: 0.21, 95% CI: 0.08-0.60). Inter-reader agreement was high before and after TACE (ICC 0.999, 95% CI: 0.998-0.999 and ICC 0.998, 95% CI: 0.997-0.999, respectively).



## CONCLUSION

Changes in the total enhancing tumor volume can identify NELM patients who will experience prolonged survival as early as 1 month after TACE

## CLINICAL RELEVANCE/APPLICATION

Total enhancing tumor volume in 3D is recommended as an early imaging biomarker for survival in NELM patients treated with TACE.

## VSI051-12 Intra-arterial Therapies of GEP-NET: Techniques and Indications

Thursday, Dec. 3 4:20PM - 4:35PM Location: S405AB

### Participants

Thierry J. De Baere, MD, Villejuif, France (*Presenter*) Consultant, Terumo Corporation; Speaker, Medtronic, Inc; Consultant, General Electric Company; Consultant, Guerbet SA;

## LEARNING OBJECTIVES

1) To understand particular natural history of NET métastases and indication for local thérapies. 2) To Know intra-arterial thérapies available for NET inclusion bland embolization, TACE and radioemebolization. 3) To know published results on efficace of intra-arterial thérapies on NET livre métastases. 4) To know about possible complications of intra-arterial thérapies on NET livre métastases.

## ABSTRACT

gastro-entero pancreatic-neuroendocrine tumors (GEP-NET) from small intestine and pancreas are most common cause of NET liver metastases. Grade 1 (carcinoid / < 2 mitoses / 10 microscopic fields and Ki-67 < 2%) and grade 2 (well- differentiated / 2 to 20 mitoses and Ki-67 from 3 to 20%) (1) are potential candidate for liver directed therapies where G3 carcinoma are candidate for systemic treatment (2). For secretory syndrome, liver directed therapies are second line treatment after somatostatin analogs. For control of tumor growth, liver directed therapies are used upon progression or for large tumor burden. Intra-arterial therapies combine occlusion of the tumor feeders, with or without chemotherapy or radiation therapy including trans-arterial chemoembolization (TACE), trans-arterial embolization (TAE), and radioembolization (RE). GEP NET liver metastases are usually bilobar and two sessions of treatment will be delivered sequentially 4-8 weeks apart to each lobes. If the tumors are in small number, hyper-selective will be delivered. Patients with >75% of liver involvement must be treated a few segments of liver at once, and will require several sessions. Contraindications includes liver insufficiency, obstructive jaundice, bilioenteric anastomoses, portal vein thrombosis and renal insufficiency (3). In bilioenteric anastomoses or portal vein thrombosis RE could be an interesting alternative in early reports (4). TACE using Lipiodol used for more than 20 years provides 52-86 % response on the secretory syndrome for over 12 months (5, 6). OS has a median of 38.6 months (33-55 months for non-pancreatic-NET and 23-43 months for pancreatic-NET) (7-9). Our recent unpublished data highlight a median OS of 7 year in 103 patients treated with TACE for G1 and G2 GEP NET. A review of 148 patients treated with 185 radio-embolization procedures (CR:2.7%, PR:60.5%, SD:22.7%, PD:4.9%) reported a Median OS of 70 months, with no radiation-induced liver disease (10). Grade 3 or higher adverse events were fatigue (6.5%), nausea (3.2%), pain (2.7%), and ascites (0.5%).

## VSI051-13 Y-90-4mNET

Thursday, Dec. 3 4:35PM - 4:50PM Location: S405AB

### Participants

Steven C. Rose, MD, San Diego, CA (*Presenter*) Stockholder, Sirtex Medical Ltd; Proctor, Sirtex Medical Ltd; Scientific Advisory Board, Surefire Medical, Inc; Consultant, Surefire Medical, Inc; Stockholder, Surefire Medical, Inc; Consultant, Embolx, Inc

## VSI051-14 SW43-DOX Loaded DEB-TACE, a Potential New Drug Delivery Platform - An in Vitro Evaluation

Thursday, Dec. 3 4:50PM - 5:00PM Location: S405AB

### Participants

Johannes M. Ludwig, Pittsburgh, PA (*Presenter*) Nothing to Disclose  
Yongkang Gai, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Sun Lingyi, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Dexing Zeng, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Hyun S. Kim, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose

## RESULTS

Fluorescence Microscopy showed specific binding of SW43-DOX-Cy3 in Panc-1, HT-29 & HEPG2 cells. Panc-1 cells showed a specific uptake of SW43-DOX-Lu177 at .5h (0.83 nmol/mg prot.), which increased to 1.36 and 1.21 nmol/mg prot. at .5h and 3h (p<.01) respectively. Compared to DOX, SW43-DOX demonstrated significantly superior viability reduction (at least p<.01 for all comparison) of PANC-1 of cells treated with DOX or SW43-DOX: 98.7% vs. 64% (25µM) and 88.3% vs. 33.3% (50µM) after 6h; 46.6% vs. 30.6% (25µM) and 39.5% vs. 5.3% (50µM) after 24 h and 15% vs. 2.9% (25µM) and 9.5% vs. 0.54% (50µM) after 48 h. Results from HEPG2, besides 25 µM (6h) & 50 µM (48h), and HT-29 cells also proved statistical superiority of SW43-DOX over DOX (p<.01). Loading on DEB was 95% within 24h.

## CLINICAL RELEVANCE/APPLICATION

Preclinical Evaluation.

## VSI051-15 Theranostic Approaches to the Management of Neuroendocrine Tumors

Thursday, Dec. 3 5:00PM - 5:15PM Location: S405AB

### Participants

Chaitanya Divgi, MD, New York, NY (*Presenter*) Nothing to Disclose

## VSI051-16 Intra-arterial Therapy in Liver Metastases: The 5 Best Papers of the Past Year?

Thursday, Dec. 3 5:15PM - 5:30PM Location: S405AB

Participants

Ricardo D. Garcia-Monaco, MD, PhD, Buenos Aires, Argentina (*Presenter*) Consultant, CeloNova BioSciences, Inc ; Consultant, BTG International Ltd; Speaker, Siemens AG

**LEARNING OBJECTIVES**

1) To comprehend 5 interesting papers of the last year on intrarterial therapies of liver metastasis. 2) To update the evidence on mCRC intrarterial therapies. 3) To discuss the best laboratory research paper on the topic. 4) To discuss the largest published series on Y90 radioembolization outcome in mCRC. 5) To update the intrarterial therapies in mNET.

**VSI051-17 mNET Tumor Board**

Thursday, Dec. 3 5:30PM - 6:00PM Location: S405AB

Participants

Michael C. Soulen, MD, Philadelphia, PA (*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

Sarah B. White, MD,MS, Philadelphia, PA, (sbwhite@mcw.edu) (*Presenter*) Nothing to Disclose

Emily Bergsland, MD, San Francisco, CA (*Presenter*) Research funding, Novartis AG Research support, F. Hoffmann-La Roche Ltd Consultant, Pfizer Inc Consultant, Lexicon Pharmaceuticals, Inc Consultant, Novartis AG

Robert E. Roses, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

Thierry J. De Baere, MD, Villejuif, France (*Presenter*) Consultant, Terumo Corporation; Speaker, Medtronic, Inc; Consultant, General Electric Company; Consultant, Guerbet SA;

Chaitanya Divgi, MD, New York, NY (*Presenter*) Nothing to Disclose

Ricardo D. Garcia-Monaco, MD, PhD, Buenos Aires, Argentina (*Presenter*) Consultant, CeloNova BioSciences, Inc ; Consultant, BTG International Ltd; Speaker, Siemens AG

MSCB51

## Case-based Review of Breast (An Interactive Session)

Thursday, Dec. 3 1:30PM - 3:00PM Location: S100AB



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

### Participants

Janie M. Lee, MD, Bellevue, WA (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify the appropriate application of multimodality breast imaging for routine screening, supplemental screening, and diagnostic indications. 2) Select appropriate methods for performing imaging-guided percutaneous breast biopsy and post-biopsy radiologic-pathologic correlation. 3) Calculate performance measure values for a breast imaging audit and compare with appropriate benchmarks.

### Sub-Events

#### MSCB51A Screening: Digital Mammography and Tomosynthesis

### Participants

Helen Anne D'Alessandro, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To review the current role of screening digital mammography and tomosynthesis. 2) To demonstrate digital mammography and tomosynthesis use for evaluating screening callbacks of masses, calcifications, architectural distortion and summation artifacts. 3) To discuss tomosynthesis for decreasing callback rates, evaluating extent of disease and increasing cancer detection rates.

### ABSTRACT

This case based review will demonstrate digital mammography and tomosynthesis use for evaluating callbacks of masses, calcifications, architectural distortion and summation artifacts. Practical considerations of digital mammography and tomosynthesis will also be discussed, including the effect of digital tomosynthesis on screening callback rates, evaluating extent of disease and increasing cancer detection rates.

#### MSCB51B Supplemental Screening in an Era of Breast Density Notification Legislation

### Participants

Janice S. Sung, MD, New York, NY (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

### ABSTRACT

This talk will focus on the various imaging modalities that are available for supplemental screening for intermediate and high risk patients, including ultrasound, MRI, and contrast enhanced digital mammography. The clinical evidence supporting their use for supplemental screening will be reviewed. The advantages and disadvantages of each modality will also be reviewed during this case based session.

#### MSCB51C Evaluating the Symptomatic Patient

### Participants

Catherine M. Appleton, MD, Saint Louis, MO (*Presenter*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;

### LEARNING OBJECTIVES

1) To understand the clinical presentation of benign and malignant breast conditions. 2) To review current guidelines for evaluating the symptomatic patient. 3) To discuss specific imaging approaches for evaluating breast symptoms.

MSCA51

## Case-based Review of the Abdomen (An Interactive Session)

Thursday, Dec. 3 1:30PM - 3:00PM Location: S406A



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

### Participants

Douglas S. Katz, MD, Mineola, NY, (dkatz@winthrop.org) (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To review a series of clinically relevant, abdominal imaging cases, with audience participation. 2) To review important concepts and potential pitfalls of: the liver on sonography; the acute abdomen on US, CT, and MR; liver transplants on multi-modality imaging; genitourinary imaging; and trauma imaging 3) To provide take home points for the audience based on specific actual case material which was instructional or problematic for the presenters.

### ABSTRACT

#### Sub-Events

#### MSCA51A Hepatic Tumor Imaging

### Participants

Puneet Bhargava, MD, Shoreline, WA (*Presenter*) Editor, Reed Elsevier

### LEARNING OBJECTIVES

1) Review imaging appearances of common hepatic tumors. 2) Review key imaging findings that aid in differential diagnosis.

### ABSTRACT

#### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Puneet Bhargava, MD - 2015 Honored Educator

#### MSCA51B Abdominal Trauma Imaging

### Participants

Savvas Nicolaou, MD, Vancouver, BC (*Presenter*) Institutional research agreement, Siemens AG

### LEARNING OBJECTIVES

1) Review the technique and protocols, with an emphasis on MDCT, for imaging of blunt and penetrating abdominal and pelvic trauma. 2) Demonstrate examples of the spectrum of injuries and the accompanying management associated with abdominal trauma, including hepatic and hepatobiliary (gallbladder) injuries, bowel and mesenteric injuries, and pelvic injuries including bladder and vascular injuries. 3) Demonstrate significance of arterial and portal venous phase imaging in the setting blunt abdominal and pelvic trauma, and the utility of whole body imaging. 4) Review new imaging applications and techniques such as iterative reconstruction and dual-energy CT, which can help better image abdominal and pelvic injuries post-trauma.

### ABSTRACT

#### MSCA51C Acute Abdomen Imaging

### Participants

Stephan W. Anderson, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) The participant will be exposed to the current literature related to imaging of acute abdominal pain using CT. 2) The participant will be able to apply an evidence-based approach to CT protocol development in the imaging of acute abdominal pain. 3) The participant will be able to independently evaluate the published literature in this area in a critical fashion and continue to apply recent developments to their own practice.

PS50

## Thursday Plenary Session

Thursday, Dec. 3 1:30PM - 2:45PM Location: E450A



AMA PRA Category 1 Credits™: 1.25  
ARRT Category A+ Credits: 1.50

### Participants

### Sub-Events

#### PS50A **RSNA/AAPM Symposium: PET/MR Imaging: Translation to Practice**

### Participants

Paul E. Kinahan, PhD, Seattle, WA (*Moderator*) Research Grant, General Electric Company; Co-founder, PET/X LLC

### LEARNING OBJECTIVES

1) Describe the motivations underlying dual-modality PET/MR imaging systems. 2) Describe the role of PET/MR imaging in clinical practice and research studies. 3) List the challenges and potential solutions of advanced PET/MR imaging.

#### PS50B **PET/MR Imaging in Practice: A Clinical Perspective**

### Participants

Jonathan E. McConathy, MD, PhD, Saint Louis, MO (*Presenter*) Research Consultant, Eli Lilly and Company; Research Consultant, Blue Earth Diagnostics Ltd; Research Consultant, Siemens AG; Research support, GlaxoSmithKline plc

### LEARNING OBJECTIVES

View learning objectives under main course title.

The advent of integrated PET/MRI systems suitable for clinical use represents a major technological advance and a new frontier in multi-modality imaging. Advantages of integrated PET/MRI include reduced radiation exposure, high soft tissue contrast, motion correction, and advanced MR techniques coupled with the power of molecular imaging with PET acquired in a single session. These characteristics of PET/MRI are well suited to a range of applications in oncologic, neurologic, and cardiovascular imaging. However, important issues including cost versus patient benefit, added complexity, quantitative accuracy, and physician training need to be addressed before PET/MRI becomes widely used for routine clinical imaging. This presentation will provide an update and overview of the current as well as potential future uses of clinical PET/MRI with a focus on oncology. Promising applications for oncologic imaging including pediatric populations, neuro-oncology, lymphoma, colorectal cancer, cervical cancer, prostate cancer, and multiple myeloma will be discussed. Key aspects of imaging protocols, study interpretation, limitations, and future directions based on our clinical experience as well as results from other centers will be emphasized.

#### PS50C **PET/MR Imaging in Practice: A Research Perspective**

### Participants

Bruce R. Rosen, MD, PhD, Charlestown, MA (*Presenter*) Research Consultant, Siemens AG

### LEARNING OBJECTIVES

View learning objectives under main course title.

### Abstract

The field of molecular imaging has grown at a rapid rate in recent years, as imaging technologies enable ever-finer examination of the human brain and other organs, and as clinicians and researchers alike seek to understand the mechanisms that underlie conditions such as cancer, heart disease, brain disorders and diabetes. Early detection of disease and monitoring of potential therapeutic interventions requires technology sensitive to the subtle changes that occur at the cellular and molecular level. PET and MRI are widely used in vivo for both clinical and research applications. Used with novel MR, nuclear, and multimodal probes, these imaging modalities have begun to revolutionize the types of questions that can be asked in vivo, permitting examination of physiological and pathological functions in living cells, tissues, and organs at their most basic level. Used in combination, the individual strengths of MRI and PET can inform one another to yield new insights that expand the types of physiological information that can be gained through in vivo imaging and thus also expand the impact of human health imaging by enlarging the window of anatomical size, time scales, resolution, sensitivity, and specificity of detection for which imaging is currently used. Combined MR-PET imaging technology allows investigators to employ the benefits of MRI such as phased array coils for high speed, high resolution functional imaging, while simultaneously acquiring quantitative metabolic or receptor-specific neurochemical data. Simultaneous MR-PET imaging has the distinct advantage of spatial co-registration of biochemical function with anatomical structure. Perhaps more importantly, MR-PET allows researchers to temporally co-register physiological data using PET and functional MRI (fMRI), such that the hemodynamic information from fMRI may be used to feed quantitative analysis of PET data. Using this information, researchers can understand the interplay between blood flow, receptor occupancy, and metabolism-as well as the contributions of each in disease and therapy response. As such, combined MR-PET has significant clinical potential to impact not only all aspects of patient care, from screening to disease assessment and therapy monitoring, but also to lead to new dual-modality MR-PET probes that can provide complementary information for precise quantitative assessment of biological function not obtainable in other ways.

SPRG51

## RadioGraphics' Publication Information for Potential Authors

Thursday, Dec. 3 1:30PM - 2:45PM Location: E350

OT

AMA PRA Category 1 Credits™: 1.25  
ARRT Category A+ Credits: 1.50

### Participants

Jeffrey S. Klein, MD, Burlington, VT, (jklein@rsna.org) (*Presenter*) Nothing to Disclose  
Kimberly L. Franks, Oak Brook, IL (*Presenter*) Nothing to Disclose  
Lucinda Foulke, Oak Brook, IL (*Presenter*) Nothing to Disclose  
Stephanie Khio, Oak Brook, IL (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Prepare a format- and content-compliant manuscript for possible publication. 2) Use ScholarOne Manuscripts to submit a manuscript for possible publication. 3) Become familiar with the RadioGraphics publication process.

### ABSTRACT

The majority of material published in RadioGraphics is derived from solicited education exhibits selected by subspecialty panels at the RSNA annual meeting. This session, conducted by the RadioGraphics peer review and production staff, will review the process of developing a manuscript from your solicited exhibit and submitting your material via our online submission and peer review system ScholarOne. The components of a standard RadioGraphics manuscript will be detailed, including the creation of a CME test. There will be ample time for questions to the staff and the editor of RadioGraphics, Dr. Jeffrey Klein.

### URL

**Active Handout: Lucinda Foulke**

<http://abstract.rsna.org/uploads/2015/15001733/SPRG51.pdf>

RCC54

## The Use of Business Analytics for Improving Radiology Operations, Quality, and Clinical Performance (In Association with the Society for Imaging Informatics in Medicine)

Thursday, Dec. 3 2:30PM - 4:00PM Location: S501ABC



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

### Participants

Katherine P. Andriole, PhD, Dedham, MA (*Moderator*) Advisory Board, McKinsey & Company, Inc;

### LEARNING OBJECTIVES

1) Understand what is meant by business analytics in the context of a radiology practice. 2) Be able to describe the basic steps involved in implementing a business analytics tool. 3) Learn how business analytics tools can be used for quality assurance in radiology, for maintenance of certification (MOC), and for practice quality improvement. 4) Be introduced to the capabilities of current and potential future business analytics technologies.

### ABSTRACT

This course will provide an overview of the use of business analytics (BA) in radiology. How a practice manages information is becoming a differentiator in the competitive radiology market. Leveraging informatics tools such as business analytics can help a practice transform its service delivery to improve performance, productivity and quality. An introduction to the basic steps involved in implementing business analytics will be given, followed by example uses of BA tools for quality assurance, maintenance of certification (MOC) and practice quality improvement. The power of current business analytics technologies will be described, along with a look at potential future capabilities of business analytics tools.

### Sub-Events

#### RCC54A Introduction to Business Analytics Demonstrating Application to Radiology

### Participants

Katherine P. Andriole, PhD, Dedham, MA (*Presenter*) Advisory Board, McKinsey & Company, Inc;

### LEARNING OBJECTIVES

1) Gain an overview of business analytics tools and understand how they might be used in radiology. 2) Be able to describe the general steps involved in business analytics, including extract, transform, load (ETL) and key performance indicators (KPI). 3) See a demonstration implementation of an open-source business analytics tool using a radiology use case.

### ABSTRACT

This session will provide a general overview of business analytics concepts and how they can be used in radiology. A walk through of the basic steps involved in implementation including identifying, collecting, transforming, and dynamically presenting key performance indicators (KPI) will be demonstrated. The extract, transform, load (ETL) steps will be shown using an example use case, and multiple database sources taken from a radiology practice.

#### RCC54B Operational and Predictive Analytics in Radiology

### Participants

Paul G. Nagy, PhD, Baltimore, MD, (pnagy@jhu.edu) (*Presenter*) Institutional license agreement, Analytical Informatics, Inc

### LEARNING OBJECTIVES

1) Explain the big data science and radiology. 2) Identify the role of informatics in capturing, extracting, analyzing, and communication quality projects. 3) Illustrate graphical dashboarding examples to support quality efforts.

### ABSTRACT

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Paul G. Nagy, PhD - 2014 Honored Educator

#### RCC54C Capabilities of Current and Future Business Analytics Technologies

### Participants

Mindy Licurse, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To gain familiarity with currently available business technologies and their relevance to radiology practice. 2) To consider how existing business technologies can support quality assurance in radiology. 3) To learn about business analytics features that may be available/desirable in the future to augment and support both the practice of radiology.





SPSH51

## Hot Topic Session: Musculoskeletal Applications of Dual Energy CT

Thursday, Dec. 3 3:00PM - 4:00PM Location: E353C



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

### Participants

Kenneth S. Lee, MD, Madison, WI (*Moderator*) Research Consultant, SuperSonic Imagine; Consultant, Echometrix, LLC; Royalties, Reed Elsevier  
Mary G. Hochman, MD, West Roxbury, MA (*Moderator*) Stockholder, General Electric Company; Stock options, Nomir Medical Technologies, Inc; Author, UpToDate, Inc

### Sub-Events

#### SPSH51A MSK Applications of Dual Energy CT: Gout

### Participants

Jeffrey J. Peterson, MD, Neptune Beach, FL (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe the basic theory and technique of dual energy CT for detection and localization of uric acid. 2) Highlight the current role for DECT in the current clinical algorithm for the diagnosis of gout. 3) Identify the value of DECT 3D tophus quantification in the management of gout.

### ABSTRACT

### URL

### Honored Educators

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Jeffrey J. Peterson, MD - 2012 Honored Educator

#### SPSH51B MSK Applications of Dual Energy CT: Metal Artifact Reduction, Bone Marrow Edema and Tendon/Ligament Analysis

### Participants

Savvas Nicolaou, MD, Vancouver, BC (*Presenter*) Institutional research agreement, Siemens AG

### LEARNING OBJECTIVES

1) Briefly review the basic physics principles of DECT/Spectral imaging. 2) Explain the clinical utility of DECT in MSK Applications, with a focus on metal artifact reduction, bone marrow edema and tendon/ligament analysis.

SPSH55

## Hot Topic Session: Cancer Screening: Breast Tomosynthesis, CT Colonography, Lung Cancer

Thursday, Dec. 3 3:00PM - 4:00PM Location: E451A



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

### Participants

Paul P. Cronin, MD, MS, Ann Arbor, MI (*Moderator*) Nothing to Disclose

### Sub-Events

#### SPSH55A Imaging in Breast Cancer Screening

### Participants

Elizabeth S. Burnside, MD, MPH, Madison, WI (*Presenter*) Stockholder, NeuWave Medical Inc

### LEARNING OBJECTIVES

1) To review the foundation and evolution of scientific investigation that supports evidence-based breast cancer screening. 2) To critically evaluate the methodologies currently being used to construct screening guidelines. 3) To understand the outcomes by which successful screening programs are measured. 4) To review and assess the current controversies of breast cancer screening.

### ABSTRACT

### URL

#### SPSH55B Imaging in Lung Cancer Screening

### Participants

Ella A. Kazerooni, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Ella A. Kazerooni, MD - 2014 Honored Educator

#### SPSH55C Imaging in Colon Cancer Screening

### Participants

David H. Kim, MD, Madison, WI (*Presenter*) Consultant, Viatronix, Inc; Co-founder, VirtuoCTC, LLC; Medical Advisory Board, Digital ArtForms, Inc; Stockholder, Celectar Biosciences, Inc

### LEARNING OBJECTIVES

1) Be able to compare/contrast image-based screening by CT colonography (CTC) against the other screening options for colorectal cancer. 2) Be familiar with the major trials that establish the performance profile of CTC. 3) Understand the rationale for the selective polypectomy strategy at CT colonography.

SPDL51

## RSNA Diagnosis Live™: Peds, IR, Potpourri

Thursday, Dec. 3 3:00PM - 4:00PM Location: E451B



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

### Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Medical Advisory Board, Merge Healthcare Incorporated  
Brian S. Funaki, MD, Riverside, IL (*Presenter*) Data Safety Monitoring Board, Novate Medical  
Kate A. Feinstein, MD, Chicago, IL, (kfeinstein@radiology.bsd.uchicago.edu) (*Presenter*) Nothing to Disclose

### 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.

**Hot Topic Session: Molecular Neuroimaging in Dementia: State-of-the-Art and Emerging Techniques**

Thursday, Dec. 3 3:00PM - 4:00PM Location: E350



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

**FDA** Discussions may include off-label uses.

**Participants**

Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Moderator*) Royalties, General Electric Company; Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd; Research Grant, Astellas Group; Research Grant, Seattle Genetics, Inc;

Alexander Drzezga, MD, Cologne, Germany (*Moderator*) Research Grant, Eli Lilly and Company; Speakers Bureau, Siemens AG; Speakers Bureau, General Electric Company; Speakers Bureau, Piramal Enterprises Limited; Research Consultant, Eli Lilly and Company; Research Consultant, Piramal Enterprises Limited; ; ; ; ;

**Sub-Events****SPSH52A Potential of Amyloid Imaging versus MRI in the Diagnostic Workup of Dementia****Participants**

Clifford R. Jack JR, MD, Rochester, MN (*Presenter*) Stockholder, Johnson & Johnson; Research Consultant, Eli Lilly and Company; ;

**LEARNING OBJECTIVES**

1) Explain the utility of structural MRI and amyloid PET in characterizing the pattern of neurodegeneration and pathologic involvement in dementia syndromes. 2) Identify the advanced MRI techniques that provide information on disease pathophysiology in dementia. 3) Discuss cases for which MRI and amyloid PET would provide critical information for clinical assessment.

**ABSTRACT**

Development of molecular imaging agents for fibrillar  $\beta$ -amyloid ( $A\beta$ ) positron emission tomography (PET), brought molecular imaging of Alzheimer's disease (AD) pathology into the spotlight. Large cohort studies with longitudinal follow-up in cognitively normal, mild cognitive impairment and AD patients indicate that  $A\beta$  deposition can be detected many years, even decades before the onset of symptoms with molecular imaging and its progression can be followed longitudinally. The role of molecular imaging in AD clinical trials is growing rapidly especially in an era when preventive interventions are designed towards eradicating the pathology targeted by molecular imaging agents. The utility of  $A\beta$  PET in differential diagnosis of AD is greatest when there is no pathologic overlap between the two dementia syndromes such as in frontotemporal lobar degeneration and AD. However  $A\beta$  PET alone may be insufficient in distinguishing dementia syndromes that commonly have overlapping  $A\beta$  pathology, such as dementia with Lewy bodies and vascular dementia, which represent the two most common dementia pathologies after AD. MRI is recommended during the initial evaluation of dementia, in order to determine potentially treatable causes such as tumors, subdural hematoma or normal pressure hydrocephalus. In addition, presence and extent of cerebrovascular disease, which may contribute to cognitive impairment and dementia, can be determined during this initial MRI evaluation. Pattern of structural MRI changes reflect neurodegenerative pathology and are closely associated with the clinical disease severity in AD. Although  $A\beta$  deposition is the most common pathologic process observed in dementia patients, other pathologic processes such as loss of neuronal integrity and connectivity can be measured with the advanced MRI techniques and complement  $A\beta$  PET.

**URL****SPSH52B Imaging Inflammation and Molecular Pathology in Dementia****Participants**

Ana M. Catafau, MD, PhD, Barcelona, Spain, (ana.catafau@piramal.com) (*Presenter*) Employee, Piramal Imaging GmbH

**LEARNING OBJECTIVES**

1) Explain potential clinical applications of different molecular pathology PET tracers. 2) List different targets for neuroinflammation PET imaging. 3) Describe advantages and disadvantages of different PET targets for neuroinflammation imaging. 4) Identify challenges for the development of molecular pathology tracers for neurodegenerative disorders.

**ABSTRACT**

Clinical classifications of neurodegenerative disorders are often based on neuropathology. The term „proteinopathies“ includes disorders that have in common abnormal proteins as a hallmark, e.g. amyloidoses, tauopathies, synucleopathies, ubiquitinopathies. Different proteins can also co-exist in the same disease. To further complicate the pathophysiology scenario, not only different proteins, but also cells are believed to play an active role in neurodegeneration, in particular those participating in neuroinflammatory processes in the brain, such as activated microglia and astrocytes. In clinical practice, differentiating pathophysiology from clinical symptoms to allow accurate clinical classification of these disorders during life, becomes difficult in absence of biomarkers for these pathology hallmarks. PET imaging can be a useful tool in this context. Using PET tracers targeting misfolded proteins it will be possible to identify the presence or absence of the target, to depict the cerebral distribution and to quantify the protein load in different cerebral regions, as well as to monitor changes over time. Beta-amyloid is one of the proteins involved in neurodegenerative disorders, which is currently suitable to be imaged by means of PET. Research efforts are currently ongoing in order to identify new PET tracers targeting non-amyloid PET tracers for neurodegeneration. This presentation will focus on the investigational PET tracers targeting tau and alpha-synuclein as misfolded proteins, and activated microglia and astrocytes as cellular targets for neuroinflammation.

**URL**

## **SPSH52C Tau Imaging. Scientific Tool or Diagnostic Biomarker?**

### Participants

Jonathan E. McConathy, MD, PhD, Saint Louis, MO (*Presenter*) Research Consultant, Eli Lilly and Company; Research Consultant, Blue Earth Diagnostics Ltd; Research Consultant, Siemens AG; Research support, GlaxoSmithKline plc

### **LEARNING OBJECTIVES**

1) Participants will be familiar with the current status of PET tracers targeting tau that are being used in human research studies and understand their potential roles in therapeutic trials and clinical neuroimaging.

### **ABSTRACT**

Imaging biomarkers for Alzheimer's disease (AD) and other neurodegenerative diseases are playing an increasingly important role in both research and patient care. Abnormal deposition of the tau and beta-amyloid proteins are pathologic hallmarks of AD, and several PET tracers targeting tau are now available for human research studies. The optimal use and sequencing of imaging biomarkers in the evaluation of cognitive impairment and dementia are active areas of investigation. In this presentation, current and potential future applications of tau-PET will be discussed in the context of both research studies and possible clinical applications.

SPSH54

## Hot Topic Session: Imaging-guided Radiation Therapy

Thursday, Dec. 3 3:00PM - 4:00PM Location: S404AB



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

### Participants

Lei Xing, PhD, Stanford, CA (*Moderator*) Research Grant, Varian Medical Systems, Inc

### Sub-Events

#### SPSH54A Projection and Volumetric X-ray Imaging and Their Roles in Image-Guided Radiation Therapy

### Participants

Ning Jeff Yue, PhD, New Haven, CT, (yuenj@rutgers.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe the current status of x-ray imaging modalities that are used in radiotherapy 2) Explain the roles and importance of 2D, 3D and 4D x-ray Imaging in radiotherapy. 3) Assess the limitation of current x-ray imaging modality in radiotherapy. 4) Explore the potential imaging technical advancement in radiotherapy.

### ABSTRACT

#### SPSH54B Recent Advancements in PET/CT and PET/CT-Guided Radiation Therapy

### Participants

Stephen R. Bowen, PhD, Seattle, WA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand the role of 3D and 4D PET/CT in radiation therapy planning. 2) Understand the role of PET/CT in treatment response assessment for adaptive radiation therapy. 3) Describe image guidance techniques using PET/CT in charged particle therapy.

#### SPSH54C MRI-based Treatment Planning and Therapeutic Assessment - Where Do We Stand?

### Participants

Lei Xing, PhD, Stanford, CA (*Presenter*) Research Grant, Varian Medical Systems, Inc

### LEARNING OBJECTIVES

1) Present background knowledge of MR and MR simulation for radiation therapy. 2) Describe essential roles of MRI in radiation therapy treatment planning, target definition, treatment planning and verification, and therapeutic assessment. 3) Highlight recent advancements and emerging applications of MR imaging in radiation therapy.

SPSH53

## Hot Topic Session: 4D Flow Cardiac MRI

Thursday, Dec. 3 3:00PM - 4:00PM Location: S402AB

**CA** **MR**

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

**FDA** Discussions may include off-label uses.

### Participants

J. Paul Finn, MD, Los Angeles, CA (*Moderator*) Research Grant, Bracco Group; ; ;  
Robert M. Steiner, MD, Philadelphia, PA (*Moderator*) Consultant, Educational Symposia; Consultant, Johnson & Johnson

### Sub-Events

#### SPSH53A 4D Flow: Overview of Techniques and Applications

##### Participants

James C. Carr, MD, Chicago, IL (*Presenter*) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

##### LEARNING OBJECTIVES

1) Understand the basic principles behind flow imaging with MRI. 2) Become familiar with various techniques for 4d flow. 3) Briefly introduce current and future clinical applications for 4D flow.

#### SPSH53B Assessment of Congenital Heart Disease with 4D Flow

##### Participants

Christopher J. Francois, MD, Madison, WI (*Presenter*) Research support, General Electric Company

##### LEARNING OBJECTIVES

1) How can 4D Flow MRI be used in congenital heart disease? 2) What evidence supports the use of 4D Flow MRI in congenital heart disease? 3) What are current challenges of performing 4D Flow MRI in congenital heart disease? 4) What are the future directions for 4D Flow MRI in congenital heart disease?

##### ABSTRACT

How can 4D Flow MRI be used in congenital heart disease? Free breathing high resolution magnetic resonance angiography Flow visualization Flow quantification What evidence supports the use of 4D Flow MRI in congenital heart disease? Summarize published data validating flow quantification and distribution in CHD What are current challenges of performing 4D Flow MRI in congenital heart disease? Shorten scan time Respiratory and cardiac motion Accuracy of flow quantification What are the future directions for 4D Flow MRI in congenital heart disease? Energy losses in CHD Combining 4D Flow MRI with computational fluid dynamics and 3D printing

##### URL

**Active Handout:** Christopher Jean-Pierre Francois

<http://abstract.rsna.org/uploads/2015/15007123/SPSH53B.pdf>

#### SPSH53C 4D Flow Applications in Adult Cardiovascular Diseases

##### Participants

Michael D. Hope, MD, San Francisco, CA, (michael.hope@ucsf.edu) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) Assess the potential clinical utility of recent advancements in 4D Flow imaging for adult cardiovascular disease. 2) Discuss possible clinical applications of unique 4D Flow hemodynamic parameters including regional aortic pulse wave velocity, flow displacement and helicity, and turbulence.

#### SPSH53D Clinical Processing of 4D Flow for Congenital and Acquired Structural Heart Disease

##### Participants

Albert Hsiao, MD, PhD, San Diego, CA, (hsiao@ucsd.edu) (*Presenter*) Founder, Arterys, Inc; Consultant, Arterys, Inc; Research Grant, General Electric Company

##### LEARNING OBJECTIVES

1) Clinical validation for quantitative flow and function. 2) Large volume data sets, data handling, compressed-sensing iterative reconstruction. 3) Background eddy-current correction. 4) Routine clinical cardiovascular 4D Flow cases.

**Active Handout:** Albert Hsiao

<http://abstract.rsna.org/uploads/2015/15047996/SPSH53D.pdf>

MSCA52

## Case-based Review of the Abdomen (An Interactive Session)

Thursday, Dec. 3 3:30PM - 5:00PM Location: S406A



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

### Participants

Douglas S. Katz, MD, Mineola, NY, (dkatz@winthrop.org) (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To review a series of clinically relevant, abdominal imaging cases, with audience participation. 2) To review important concepts and potential pitfalls of: the liver on sonography; the acute abdomen on US, CT, and MR; liver transplants on multi-modality imaging; genitourinary imaging; and trauma imaging. 3) To provide take home points for the audience based on specific actual case material which was instructional or problematic for the presenters.

### ABSTRACT

#### Sub-Events

#### MSCA52A Abdominal Transplant Imaging

### Participants

Matthew T. Heller, MD, Pittsburgh, PA, (hellermt@upmc.edu) (*Presenter*) Consultant, Reed Elsevier; Author, Reed Elsevier

### LEARNING OBJECTIVES

1) Describe normal post-operative imaging of liver transplantation. 2) Categorize the complications of liver transplantation and summarize common imaging findings. 3) Integrate the role of imaging in the treatment plan of the transplant patient.

### ABSTRACT

#### Active Handout: Matthew Thomas Heller

[http://abstract.rsna.org/uploads/2015/15002757/MSCA52A Hepatic Transplantation.pdf](http://abstract.rsna.org/uploads/2015/15002757/MSCA52A%20Hepatic%20Transplantation.pdf)

#### MSCA52B Adrenal Imaging

### Participants

Julie H. Song, MD, Providence, RI, (jsong2@lifespan.org) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Recognize the imaging appearances of common adrenal masses and review uncommon lesions. 2) Understand the principles of imaging characterization of adrenal masses and apply imaging tools appropriately. 3) Learn to avoid pitfalls and misdiagnoses of adrenal lesions.

#### MSCA52C Hepatic Sonography: Pearls and Pitfalls

### Participants

Terry S. Desser, MD, Stanford, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Correctly identify common and uncommon sonographic pathology in the liver. 2) Use your understanding of basic sonographic and physiologic principles to infer the correct diagnosis in unusual ultrasound cases.

#### Active Handout: Terry S. Desser

[http://abstract.rsna.org/uploads/2015/15002759/Active MSCA52C.pdf](http://abstract.rsna.org/uploads/2015/15002759/Active%20MSCA52C.pdf)



MSCB52

## Case-based Review of Breast (An Interactive Session)

Thursday, Dec. 3 3:30PM - 5:00PM Location: S100AB



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

### Participants

Janie M. Lee, MD, Bellevue, WA (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify the appropriate application of multimodality breast imaging for routine screening, supplemental screening, and diagnostic indications. 2) Select appropriate methods for performing imaging-guided percutaneous breast biopsy and post-biopsy radiologic-pathologic correlation. 3) Calculate performance measure values for a breast imaging audit and compare with appropriate benchmarks.

### Sub-Events

#### MSCB52A Percutaneous Breast Biopsies

### Participants

Wendy B. Demartini, MD, Madison, WI (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand the advantages and limitations of percutaneous breast biopsy. 2) Compare the different potential methods of core needle biopsy. 3) Apply techniques for the biopsy of routine and challenging cases using mammography, ultrasound and MRI guidance.

### ABSTRACT

#### MSCB52B Radiologic-Pathologic Correlation

### Participants

Heidi R. Umphrey, MD, Birmingham, AL (*Presenter*) Research support, General Electric Company

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### MSCB52C Performance Measures

### Participants

Janie M. Lee, MD, Bellevue, WA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify the data to be collected and calculate performance measures for the basic clinically relevant breast imaging audit. 2) Compare audit results with appropriate performance benchmarks. 3) Understand additional data and calculations needed to perform a comprehensive breast imaging audit.

**MR Imaging-guided Breast Biopsy (Hands-on)**

Thursday, Dec. 3 4:30PM - 6:00PM Location: E260



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

**Participants**

Peter R. Eby, MD, Seattle, WA, (peter.eby@virginiamason.org) (*Moderator*) Consultant, Devicor Medical Products, Inc  
 Beatriz E. Adrada, MD, Houston, TX (*Presenter*) Nothing to Disclose  
 Sandra Brennan, MBBCh, MSc, West Harrison, NY (*Presenter*) Nothing to Disclose  
 Selin Carkaci, MD, Columbus, OH (*Presenter*) Author with royalties, Reed Elsevier  
 Chloe M. Chhor, MD, New York, NY (*Presenter*) Nothing to Disclose  
 Mark J. Dryden, MD, Houston, TX (*Presenter*) Nothing to Disclose  
 Sujata V. Ghatge, MD, Durham, NC (*Presenter*) Nothing to Disclose  
 Vilett A. Loving, MD, Gilbert, AZ, (vloving@mdanderson.org) (*Presenter*) Nothing to Disclose  
 Michelle D. McDonough, MD, Jacksonville, FL, (McDonough.michelle@mayo.edu) (*Presenter*) Nothing to Disclose  
 Virginia M. Molleran, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose  
 Habib Rahbar, MD, Seattle, WA (*Presenter*) Research grant, GE Healthcare  
 Jean M. Seely, MD, Ottawa, ON (*Presenter*) Nothing to Disclose  
 Stephen J. Seiler, MD, Dallas, TX, (stephen.seiler@utsouthwestern.edu) (*Presenter*) Nothing to Disclose  
 Laura B. Shepardson, MD, Cleveland, OH (*Presenter*) Nothing to Disclose  
 Tanya W. Moseley, MD, Houston, TX (*Presenter*) Nothing to Disclose  
 Roberta M. Strigel, MD, MS, Madison, WI, (rstrigel@uwhealth.org) (*Presenter*) Research support, General Electric Company  
 Janice S. Sung, MD, New York, NY (*Presenter*) Nothing to Disclose  
 Lilian Wang, MD, Chicago, IL (*Presenter*) Nothing to Disclose  
 Annamaria Wilhelm, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose  
 Simone Schradang, MD, Aachen, Germany (*Presenter*) Nothing to Disclose  
 Bethany L. Niell, MD, Boston, MA (*Presenter*) Nothing to Disclose  
 Jocelyn A. Rapelyea, MD, Washington, DC (*Presenter*) Consultant, General Electric Company

**LEARNING OBJECTIVES**

1) Explain why MR-guided breast biopsy is needed for patient care. 2) Identify relative and absolute contraindications to MR-guided breast biopsy. 3) Describe criteria for MR-guided breast biopsy patient selection. 4) Debate risks and benefits of pre-biopsy targeted ultrasound for suspicious MRI findings. 5) Understand basic MR-guided biopsy parameters and requirements for appropriate coil, needle and approach selection. 6) Manage patients before, during and after MR-guided breast biopsy. 7) Define benefits and limitations of MR-guided vacuum assisted breast biopsy. 8) Apply positioning techniques to challenging combinations of lesion location and patient anatomy for successful MR-guided biopsy.

**ABSTRACT**

This course is intended to provide basic didactic instruction and hands-on experience for MR-guided breast biopsy. Because of the established role of breast MRI in the evaluation of breast cancer through screening and staging, there is a proven need for MR-guided biopsy of the abnormalities that can only be identified at MRI. This course will be devoted to the understanding and identification of: 1) appropriate patient selection 2) optimal positioning for biopsy 3) target selection and confirmation 4) various biopsy technologies and techniques 5) potential problems and pitfalls and 6) practice audits. Participants will spend 30 minutes in didactic instruction followed by 60 minutes practicing MR-guided biopsy using provided phantoms. Various combinations of full size state-of-the-art breast MRI coils, biopsy localization equipment and needles from multiple different vendors will be available for hands-on practice. Some stations will have monitors loaded with targeting software. Expert breast imagers from around the world will be at each of 10 stations to provide live coaching, tips, techniques and advice.

**Active Handout: Peter R. Eby**

<http://abstract.rsna.org/uploads/2015/6005779/RC750.pdf>

**Real-time Interventional US (Hands-on)**

Thursday, Dec. 3 4:30PM - 6:00PM Location: E264



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

**Participants**

Christopher A. Molvar, MD, Maywood, IL (*Moderator*) Nothing to Disclose  
Kent T. Sato, MD, Chicago, IL (*Presenter*) Nothing to Disclose  
Albert A. Nemcek JR, MD, Chicago, IL (*Presenter*) Consultant, B. Braun Melsungen AG  
Robert J. Lewandowski, MD, Chicago, IL, (r-lewandowski@northwestern.edu) (*Presenter*) Advisory Board, BTG International Ltd; Advisory Board, Boston Scientific Corporation; Consultant, Cook Group Incorporated; Consultant, ABK Medical Inc  
Ramona Gupta, MD, Chicago, IL (*Presenter*) Nothing to Disclose  
Terry D. Wilkin, MD, South Bend, IN (*Presenter*) Nothing to Disclose  
Kevin L. Keele, MD, Harvey, IL (*Presenter*) Nothing to Disclose  
Michael H. Hamblin, MD, Evanston, IL (*Presenter*) Nothing to Disclose  
Terence A. Matalon, MD, Philadelphia, PA, (matalont@einstein.edu) (*Presenter*) Speaker, Koninklijke Philips NV  
Elias Hohlastos, MD, Chicago, IL (*Presenter*) Nothing to Disclose  
Andrew J. Lipnik, MD, Nashville, TN, (andrew.j.lipnik@vanderbilt.edu) (*Presenter*) Nothing to Disclose  
Christopher Baron, MD, Nashville, TN (*Presenter*) Nothing to Disclose  
Parag M. Amin, MD, Chicago, IL (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Acquire the skill to direct a needle to a target for diagnostic or therapeutic purposes with Real-time US-guidance.

**ABSTRACT**

Participants will have the opportunity to hone their skills in ultrasound guided interventions using phantoms. Experienced practitioners in ultrasound guided intervention will serve as faculty.

RC712

## Thoracic Aorta: The Essentials (An Interactive Session)

Thursday, Dec. 3 4:30PM - 6:00PM Location: S103CD

CH VA

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

### Participants

Dominik Fleischmann, MD, Palo Alto, CA (*Moderator*) Research support, Siemens AG;

### Sub-Events

#### RC712A The Spectrum of Type A Dissections

### Participants

Anne S. Chin, MD, Palo Alto, CA (*Presenter*) Nothing to Disclose

### 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.

#### RC712B Surgical Procedures and Complications

### Participants

Terri J. Vrtiska, MD, Rochester, MN (*Presenter*) Nothing to Disclose

### 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 thoracoabdominal 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

#### RC712C Traumatic Aortic Injuries

### Participants

Savvas Nicolaou, MD, Vancouver, BC (*Presenter*) Institutional research agreement, Siemens AG

### LEARNING OBJECTIVES

1) Discuss the different mechanisms of injuries, pathophysiology, and types of traumatic aortic injuries including aortic dissection, laceration, transection, pseudoaneurysm and intramural hematoma. 2) Review techniques and advances in imaging including DECT/Spectral and ultra-high-pitch imaging to optimize imaging of traumatic aortic injuries and the role of gating, MRI, and TEE. 3) Discuss and demonstrate examples of the grading scheme for traumatic aortic injuries. 4) Demonstrate imaging pitfalls which can cause misinterpretation of traumatic aortic injuries. 5) Review the appropriate management and treatment options, including open surgical repair and percutaneous endovascular repair, for the traumatic aortic injuries.

### ABSTRACT

RC716

## Radiological and Nuclear Terrorism: Like It or Not, Radiology Professionals Will Be in the 'Hot' Seat

Thursday, Dec. 3 4:30PM - 6:00PM Location: S103AB

HP OT

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

FDA Discussions may include off-label uses.

### Participants

Donald P. Frush, MD, Durham, NC (*Moderator*) Nothing to Disclose  
John Lanza, MD, Pensacola, FL, (JohnJ.Lanza@FLHealth.gov) (*Presenter*) Nothing to Disclose  
Nick Dainiak, MD, Oak Ridge, TN, (Nick.Dainiak@orau.org) (*Presenter*) Nothing to Disclose  
Judith L. Bader, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To describe the scenarios for an radiological dispersal device (RDD) or improvised nuclear device (IND). 2) To discuss roles of federal, state, and local governments. 3) To review the roles and strategies of hospital teams, including radiology professionals in the setting of an RDD/IND. 4) To provide resources for radiology professionals for response in the setting of RDD/IND. 5) Describe the very large mass casualty scenarios of concern that radiologists might be called to help with. 6) Understand is the difference between radiation contamination and exposure. 7) Understand the clinical strategies used to manage contamination and exposure. 8) Identify internet resources physicians can use to inform themselves about preparing for and participating in responses to these types of incidents.

### ABSTRACT

### URL

[http://escambia.floridahealth.gov/programs-and-services/emergency-preparedness-and-response/\\_documents/rsna-radiological-professional-ppt.pptx](http://escambia.floridahealth.gov/programs-and-services/emergency-preparedness-and-response/_documents/rsna-radiological-professional-ppt.pptx)

## Imaging Tumor Response: Old and New Challenges

Thursday, Dec. 3 4:30PM - 6:00PM Location: S102AB

**BQ** **MR** **OI**

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

### Participants

### Sub-Events

#### RC718A Reporting Cancer Response-Practical Perspective

### Participants

Elena K. Korngold, MD, Portland, OR (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

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

#### RC718B Prostate Cancer Treatment Assessment

### Participants

Hedvig Hricak, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

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

### ABSTRACT

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

#### RC718C Evaluating Response in Targeted Therapy of Abdominal Malignancy

### Participants

Yves M. Menu, MD, Paris, France (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

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

### ABSTRACT

Abdominal malignancies are very common. Imaging is pivotal for detection, staging and evaluation of tumor response to treatment. As targeted therapies are increasingly administered, the necessity for an update of tumor response criteria has become obvious. Tumor size and anatomy is still required important information, but evaluation of tissue viability is increasingly needed. Another specificity of abdominal malignancies is the increasing number of patients who are candidates for an integrated approach including systemic therapies, local therapies, radiation therapy and surgery. This underlines the necessity of a team approach and the major role of the radiologist within this group. In Hepatocellular Carcinoma (HCC), targeted therapies are widely used and mainly aimed at palliation, although potential downstaging may lead to reconsider this position. mRECIST criteria have been developed specifically

for HCC and are considered as the international standard nowadays. In secondary liver tumors, targeted therapies are usually administered in association with cytotoxic drugs. As up to 30% of patients with liver metastases from colon cancer might become resectable, the evaluation is not limited to volumetric response. The report should mention in addition relevant information on tumor viability and aggressiveness and also comment on useful elements for guidance of potential surgery or intervention. In other abdominal advanced malignancies, targeted therapies are not yet standard. However, due to the poor prognosis of these diseases, very active research develops in this field and interestingly favors a better selection of patients. Imaging may play a role with this issue, like classifying locally advanced vs metastatic patients as well as highly vs less aggressive tumors. In summary, the Radiologist should have knowledge of the main clinical challenges, of ongoing and potential treatments in order to provide relevant information to the Multi Disciplinary Team.

## **RC718D Evaluation of Lung Cancer Response**

Participants

Jeremy J. Erasmus, MD, Houston, TX (*Presenter*) Nothing to Disclose

### **LEARNING OBJECTIVES**

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

### **ABSTRACT**

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

### **Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Jeremy J. Erasmus, MD - 2015 Honored Educator

RC731

## Common Spinal Injection Procedures for Diagnosis and Treatment of Back Pain (Hands-on)

Thursday, Dec. 3 4:30PM - 6:00PM Location: E263



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

### Participants

A. Orlando Ortiz, MD, MBA, Mineola, NY (*Presenter*) Nothing to Disclose  
Bassem A. Georgy, MD, MSc, San Diego, CA (*Presenter*) Consultant, Johnson & Johnson; Consultant, DFINE, Inc; Stockholder, DFINE, Inc ; Stockholder, Spine Solutions, Inc; ;  
Allan L. Brook, MD, Bronx, NY (*Presenter*) Advisor, Johnson & Johnson Advisor, Medtronic, Inc  
Afshin Gangi, MD, PhD, Strasbourg, France (*Presenter*) Nothing to Disclose  
Todd S. Miller, MD, Bronx, NY, (Tmiller@montefiore.org) (*Presenter*) Nothing to Disclose  
Stanley Golovac, MD, Merritt Island, FL (*Presenter*) Consultant, St. Jude Medical, Inc; Investigator, Vertos Medical Inc; Investigator, St. Jude Medical, Inc

### LEARNING OBJECTIVES

1) Describe and demonstrate methods for patient selection, evaluation and technique for Image-guided injection procedures used in spine pain management. 2) These procedures will include epidural steroid injections, nerve root blocks, facet blocks, sacroiliac joint injections, lumbar synovial cyst therapy, radiofrequency ablations. 3) Review procedural complications and how to avoid them. 4) Discuss pertinent anatomy, instruments and pharmacology. 5) These objectives will be accomplished using didactic lectures complemented by procedure videos, supervised hands on lab work with training models and round table case discussions.

### ABSTRACT

Neck and back pain complaints are very common in the general population. Radiologists can contribute to the diagnosis and management in patients who are not responding to conservative management. Spine injection procedures can frequently be performed on an outpatient basis with a brief recovery phase. These procedures are performed with imaging guidance, such as a multi-directional fluoroscope or under CT guidance, in order to correctly localize the specific anatomic sites in or about the spine for diagnostic and or therapeutic needle localization. An understanding of patient selection, indications and contraindications, are paramount to the safety and success of these procedures. The diagnostic and therapeutic potential of these procedures is also facilitated by a thorough evaluation of the spine, with respect to both anatomy and potential pathology, with cross sectional imaging techniques as well as other radiologic tests. Communication of these results between the Radiologist and the spine proceduralist will contribute to optimal patient outcomes.

### Handout: Afshin Gangi

[http://abstract.rsna.org/uploads/2015/3010360/lumbar\\_inj.pptx](http://abstract.rsna.org/uploads/2015/3010360/lumbar_inj.pptx)

### Active Handout: Todd Stuart Miller

[http://abstract.rsna.org/uploads/2015/3010360/RC731\\_MBB\\_Facets\\_MILLER.pptx.pdf](http://abstract.rsna.org/uploads/2015/3010360/RC731_MBB_Facets_MILLER.pptx.pdf)



RCC55

## RadLex®: Overview of a New Lexicon for Radiology

Thursday, Dec. 3 4:30PM - 6:00PM Location: S501ABC



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

### Participants

### Sub-Events

#### RCC55A Overview of RadLex®

### Participants

Kenneth C. Wang, MD, PhD, Ellicott City, MD, (kcwang@gmail.com) (*Presenter*) Co-founder, DexNote, LLC;

### LEARNING OBJECTIVES

1) Review the rationale for developing a lexicon for medical imaging. 2) See how an imaging lexicon can be used for education, research, and clinical reporting. 3) Understand the key technical factors in creating 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 unifies 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 RadLex-based applications in structured reporting, radiology information retrieval, image annotation, image navigation and decision support. 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. The RadLex Playbook system for standardized radiology procedure names and codes will also be reviewed.

#### RCC55B 'RadLex Inside': Information Retrieval, Radiology Reporting, and Beyond

### Participants

Charles E. Kahn JR, MD, MS, Philadelphia, PA, (charles.kahn@uphs.upenn.edu) (*Presenter*) Nothing to Disclose

### 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.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Charles E. Kahn JR, MD, MS - 2012 Honored Educator

#### RCC55C ACR Usage of RadLex® Playbook for CT Dose Registry

### Participants

Kalpana M. Kanal, PhD, Seattle, WA, (kkanal@uw.edu) (*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.

RC714

## Venous Disease

Thursday, Dec. 3 4:30PM - 6:00PM Location: S504AB

**IR**

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

**FDA**

Discussions may include off-label uses.

### Participants

Anne C. Roberts, MD, La Jolla, CA (*Presenter*) Nothing to Disclose

Gerant M. Rivera-Sanfeliz, MD, San Diego, CA, (gerantrivera@ucsd.edu) (*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: Gerant M. Rivera-Sanfeliz

[http://abstract.rsna.org/uploads/2015/13010573/ACTIVE RC714.pdf](http://abstract.rsna.org/uploads/2015/13010573/ACTIVE_RC714.pdf)

RC717

## Elastography-Imaging Tissue Stiffness: Approaches and Applications

Thursday, Dec. 3 4:30PM - 6:00PM Location: S505AB

MR US PH

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

FDA Discussions may include off-label uses.

### Participants

Juergen K. Willmann, MD, Stanford, CA (*Moderator*) Research Consultant, Bracco Group; Research Consultant, Triple Ring Technologies, Inc; Research Grant, Siemens AG; Research Grant, Bracco Group; Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company

### LEARNING OBJECTIVES

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

### Sub-Events

#### RC717A US Elastography of the Liver

### Participants

Richard G. Barr, MD, PhD, Campbell, OH (*Presenter*) Consultant, Siemens AG; Consultant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, SuperSonic Imagine; Speakers Bureau, Koninklijke Philips NV; Research Grant, Bracco Group; Speakers Bureau, Siemens AG; Consultant, Toshiba Corporation; Research Grant, Esaote SpA

### LEARNING OBJECTIVES

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

### ABSTRACT

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

#### RC717B Non-liver Applications of US Elastography

### Participants

Anthony E. Samir, MD, Boston, MA, (ASAMIR@mgh.harvard.edu) (*Presenter*) Consultant, Pfizer Inc; Consultant, General Electric Company; Consultant, PAREXEL International Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, Toshiba Corporation; Research Grant, General Electric Company; Research Grant, Samsung Electronics Co, Ltd; Research Grant, Analogic Corporation; Research support, SuperSonic Imagine; Research support, Hitachi, Ltd

### LEARNING OBJECTIVES

1) This refresher course provides a summary of current state-of-the-art Ultrasound (US) elastography methods in non-hepatic conditions including thyroid nodules, prostate cancer, deep vein thrombosis and renal fibrosis and neoplasms.

### ABSTRACT

(1) A brief discussion of the evolution of SE over 20 years; physics primer including tissue elasticity, strain, shear wave and Young modulus; classification: quasi-quantitative method (strain elastography, elasticity ratio), quantitative methods by shear wave and comparison of various methods in terms of their advantages and limitations.(2) A discussion of applications of SE techniques in non-hepatic conditions. We compare diagnostic performance and reliability advantages and limitations of various SE techniques.A. Thyroid:SE methods can be used for differentiating benign and malignant thyroid nodules. It may be especially helpful for a group of indeterminate nodules with follicular lesions finding on fine needle aspirationB. Kidney:SE may be useful for detecting renal fibrosis. SE may also has adjunctive role in diagnosis of renal masses.C. Prostate:The main role of SE is prostate cancer detection, and assistance with biopsy targeting.D. Pancreas:SE methods can be used to evaluate the pancreas by upper gastrointestinal endoscopy.E. Deep vein thrombosis:Main clinical application of SE can be measuring time-dependent viscoelastic properties (aging) of blood clots in venous system.SE is a rapidly evolving set of methods that have a promising role as a biomarker in various pathologic conditions through providing information about the physical properties of the tissues that is complementary to that provided by other modalities.

Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc; Research Grant, Resoundant, Inc

#### **LEARNING OBJECTIVES**

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

#### **ABSTRACT**

Many disease processes cause profound changes in the mechanical properties of tissues. This accounts for the efficacy of palpation for detecting abnormalities and provides motivation for developing practical methods to assess tissue elasticity. Magnetic Resonance Elastography (MRE) is a new commercially-available MRI-based technique that can quantitatively image the mechanical properties of tissue. The most advanced current application of MRE is for diagnosing hepatic fibrosis. Chronic liver disease is a serious worldwide problem, and hepatic fibrosis is the most important consequence, which if not detected and treated, eventually leads to cirrhosis which is irreversible and associated with high mortality. MRE can be readily implemented on a standard MRI system. A device is used to generate vibrations in tissue. The waves are imaged with a special MRI pulse sequence. Acquisition time for liver MRE is approximately 15 seconds. Because the incremental imaging time is so small, MRE can readily be added to standard abdominal MR imaging protocols. The data are automatically processed to generate quantitative images showing the elasticity of the liver and other tissues in the upper abdomen. Clinical studies by multiple investigators have now established that MRE is an accurate method for diagnosing hepatic fibrosis. MRE-measured hepatic stiffness increases systematically with fibrosis stage. Growing clinical experience indicates that MRE is at least as accurate as liver biopsy for this diagnosis, while also being safer, more comfortable, and less expensive. Human studies have demonstrated that it is feasible to apply MRE to quantitatively assess other tissues and organs such as brain, breast, heart, and kidney. MRE may be helpful in differentiating between benign and malignant neoplasms. New research has shown that MRE is helpful in the preoperative assessment of patients with brain tumors such as meningiomas.

RC704

## Musculoskeletal Tumors

Thursday, Dec. 3 4:30PM - 6:00PM Location: S406B

**MK**

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

### Participants

Mark D. Murphey, MD, Reston, VA, (MMurphey@acr.org) (*Director*) Nothing to Disclose

### Sub-Events

#### RC704A Staging of Musculoskeletal Tumors

### Participants

David M. Panicek, MD, New York, NY, (panicekd@mskcc.org) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe the rationale and systems for staging musculoskeletal tumors. 2) List the components of local staging of musculoskeletal tumors at MRI. 3) Identify various MRI pitfalls in staging musculoskeletal tumors.

### ABSTRACT

#### RC704B Dilemmas and Pitfalls in MSK Tumor Imaging

### Participants

Mark D. Murphey, MD, Reston, VA, (MMurphey@acr.org) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Recognize the imaging differentiation of cystic lesions from myxoid neoplasms. 2) Understand the imaging appearance that allows distinction of hematoma from hemorrhagic neoplasm. 3) Identify the imaging characteristic of myositis ossificans. 4) Improve recognition of the concept of impending pathologic fracture and its clinical relevance.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Mark D. Murphey, MD - 2015 Honored Educator

#### RC704C Post-Treatment Imaging of MSK Tumors

### Participants

Mark J. Kransdorf, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Construct a framework for evaluation of patients following treatment. 2) Recognize the spectrum of post treatment imaging findings. 3) Identify features to distinguish post treatment change from recurrent tumor.

### ABSTRACT

**Active Handout:** Mark J. Kransdorf

[http://abstract.rsna.org/uploads/2015/15001697/ACTIVE\\_RC704C.pdf](http://abstract.rsna.org/uploads/2015/15001697/ACTIVE_RC704C.pdf)

#### RC704D Radiologic Treatment of MSK Tumors

### Participants

Peter L. Munk, MD, Vancouver, BC (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Familiarize the attendee with the most commonly used imaging guided per cutaneous thermal ablation techniques used in treatment of both benign tumours and metastatic disease involving the MSK system. 2) Review indications for radiologic treatment of bone tumors. 3) Examine the potential complications that can be encountered.

RC732

## Medical-Legal Hot Topics for Radiologists

Thursday, Dec. 3 4:30PM - 6:00PM Location: S502AB

LM

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

### Participants

#### LEARNING OBJECTIVES

1) Understand the importance of ensuring communication of critical radiology results. 2) Consider common reasons for perceptual errors in body imaging. 3) Familiarize themselves with some key risk management take home points in radiology.

### Sub-Events

#### RC732A Communication - An Essential Strategy for Risk Management

##### Participants

Leonard Berlin, MD, Skokie, IL (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.

#### RC732B Selected Topics in Radiology Risk Management: Errors and Communication 2015

##### Participants

Jonathan W. Berlin, MD, Evanston, IL (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.

RC702

## Tips on Effective Educational Strategies for International Outreach

Thursday, Dec. 3 4:30PM - 6:00PM Location: S403A

ED

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

### Participants

Kristen K. DeStigter, MD, Burlington, VT (*Moderator*) Medical Advisory Board, Koninklijke Philips NV; Luminary, McKesson Corporation; Research collaboration, Koninklijke Philips NV;

### Sub-Events

#### RC702A 10 Tips for an Effective Teach the Teacher Model in Low-resource Settings

### Participants

Kristen K. DeStigter, MD, Burlington, VT (*Presenter*) Medical Advisory Board, Koninklijke Philips NV; Luminary, McKesson Corporation; Research collaboration, Koninklijke Philips NV;

### LEARNING OBJECTIVES

1) Evaluate low-resource settings for potential challenges to radiology education. 2) Determine opportunities that may lead to an effective teach the teacher program. 3) Synthesize and integrate best practice tips into educational programs in low-resource settings.

#### RC702B Establishing a Pediatric Radiology Fellowship as an International Education Outreach

### Participants

Kassa Darge, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify the need for supporting pediatric imaging as an international education outreach. 2) Develop a pediatric radiology fellowship curriculum suitable for an international outreach undertaking. 3) Execute an international pediatric radiology fellowship as part of educational outreach program.

### ABSTRACT

In many economically less developed countries, the proportion of infant, children and adolescent population can be staggeringly high. The pediatric population can be as much as two-third of the total population. Despite this fact, even in those countries where some level of radiological services and residency program for radiology exist, pediatric imaging gets least priority. Many of these countries also do not even have a single pediatric radiologist. Thus supporting pediatric imaging in such countries within the context of an international education outreach is understandably justified. Collaborating with a local teaching hospital that has a radiology residency program and supporting the pediatric imaging is an easy first step to take. However, a long-term and sustainable way to improve pediatric imaging is to train the teachers in pediatric imaging i.e. conduct a pediatric radiology fellowship. This can be integrated in the institutional framework and provide a lasting and continuous support to pediatric imaging in the country. The example of the collaboration of Department of Radiology of The Children's Hospital of Philadelphia and the Department of Radiology of Addis Ababa University in Ethiopia will be used to illustrate how to establish a pediatric radiology fellowship as an international education outreach.

#### RC702C Global Health Radiology: Educational Principles and Strategies from RAD-AID

### Participants

Erica Pollack, Denver, CO (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To introduce principles and strategies for the assessment of radiology scarcity in low and middle income countries. 2) To summarize approaches used in Asia, Africa and Latin America for increasing radiology access. 3) To present key components of radiology service delivery in low and middle income countries, such as staff education, radiation safety, and image quality.

#### RC702D Effective Lecture Techniques for an International Audience

### Participants

Eric J. Stern, MD, Seattle, WA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand the potential barriers to learning when speaking to international audiences. 2) Raise awareness of possible cultural differences when teaching groups abroad. 3) Learn how to adapt your own teaching style and methods to international audiences.

RC711

## Advances and Updates in SPECT/CT

Thursday, Dec. 3 4:30PM - 6:00PM Location: S504CD

**CT** **NM**

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

**FDA** Discussions may include off-label uses.

### Participants

### Sub-Events

#### RC711A SPECT/CT in Musculoskeletal Diseases

### Participants

Christopher J. Palestro, MD, New Hyde Park, NY (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

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

### ABSTRACT

#### RC711B SPECT/CT in Endocrine Disorders and Others

### Participants

Esma A. Akin, MD, Washington, DC (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Through clinical case examples, this activity aims to refresh knowledge of SPECT-CT applications with emphasis on neuroendocrine disorders as well as parathyroid imaging.

### ABSTRACT



RC754

## Preparing your Radiology Practice and IT Department for Big Data

Thursday, Dec. 3 4:30PM - 6:00PM Location: S105AB

IN

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

### Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Moderator*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Medical Advisory Board, Merge Healthcare Incorporated

### LEARNING OBJECTIVES

1) The potential of applying "Big Data" approaches to radiology will be discussed. 2) The participant will be introduced to the importance of developing a comprehensive IT architecture and capability beyond the EMR in order to effectively use "Big Data" tools. 3) Strategies for preparing IT for "Big Data" will be discussed.

### 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. This will require optimally leveraging IT enabled business intelligence, analytics, and data driven workflow. In many ways, this challenge can be described as a "Big Data" problem, requiring the application of newer "Big Data" approaches and tools. Unfortunately, many have discovered that an "EMR centric" IT perspective may severely limit the ability for the enterprise to maximally leverage these newer tools to create differentiable value. This session will provide an introduction to the importance of developing a comprehensive architectural strategy to augment the existing EMR to more effectively consume "Big Data" tools.

### Sub-Events

#### RC754A Getting Your IT Infrastructure Ready for Big Data

### Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Medical Advisory Board, Merge Healthcare Incorporated

#### RC754B NoSQL Approaches: Beyond the Traditional Relational Database

### Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Medical Advisory Board, Merge Healthcare Incorporated

### LEARNING OBJECTIVES

1) The distinction between the traditional relational (SQL) database and "NoSQL" approaches will be discussed. 2) The attendees will be given a basic introduction to how "NoSQL" tools, such as Hadoop, MapReduce, MongoDB can be complementary to existing approaches. 3) NoSQL applications and their relevance to radiology will be discussed.

### 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. This will require optimally leveraging IT enabled business intelligence, analytics, and data driven workflow. These approaches will require the ability to consume and utilize all available enterprise data, including unstructured reports, multimedia objects, etc. Other industries have realized that traditional IT approaches, such as the relational (SQL) database, cannot optimally address these "difficult" data objects. Many outside of the medical domain have successfully augmented traditional approaches by newer "Big Data" and "NoSQL" methodologies, such as Hadoop, MapReduce, MongoDB, etc. In this session, an introduction to these newer tools will be presented.

#### RC754C Deep Learning: An Example of Big Data Applications

### Participants

Jeremy Howard, San Francisco, CA (*Presenter*) CEO, Enlitic; Shareholder, Enlitic

### LEARNING OBJECTIVES

1) A technical overview of machine learning and deep learning will be presented. 2) Applications of machine learning and deep learning in radiology will be illustrated. 3) Challenges in deploying machine learning and deep learning in radiologist workflow and productivity demands will be discussed.

### ABSTRACT

Computers in radiology have often promised to deliver faster clinical decisions, more accurate diagnoses, and transformative visualizations. Computer aided diagnostics (CAD) has been deployed to guide radiologists in their detection of abnormalities and identification of disease. Historically, CAD has been based on domain-driven heuristics, and more recently used simple machine learning on structured data. Both of these require extensive manual engineering making them very slow to build, limited in their flexibility, and less accurate than we would like. Deep learning is a new paradigm that offers a transformative solution. Instead of demanding countless human hours of painstaking feature generation and selection, deep learning automatically discovers clinically-

relevant features by first architecting a hierarchy of patterns (loosely modelled on the brain's own neural neural networks) and then updating those patterns upon observing examples. As radiology requires complex associative pattern recognition, deep learning is the ideal companion tool. Enlitic is developing a deep neural network of the entire human body that will offer a new way forward in which the radiologist has immediate access to the most relevant clinical information. In this talk, we will present a technical overview of machine learning and deep learning, illustrate its applications in radiology, and detail some of the challenges improving radiological workflow using deep learning poses.

**Personalized Medicine: Abdomen**

Thursday, Dec. 3 4:30PM - 6:00PM Location: S404CD



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

**Participants**

Kristy K. Brock, PhD, Ann Arbor, MI (*Moderator*) License agreement, RaySearch Laboratories AB;

**ABSTRACT**

The use of imaging and other biomarkers to increase the efficacy of treatment and decrease the risk of toxicity increased in the abdomen. Functional imaging and serum-based biomarkers can enable a more detailed understanding of the tumor, its characteristics, and early indications of its response to therapy. In addition, they can also be utilized to assess an individual patients risk for toxicity, enabling a personalize approach to radiotherapy. These advanced imaging techniques can be combined with anatomical information to generate high precision treatment plans which can be adapted over the course of treatment to account for identified uncertainties, changes, and deviations which may compromise the delivery of the intended treatment or identify the ability to re-optimize treatment to improve the therapeutic ration. In this session, technical and clinical concepts will be described to design and deliver personalized radiotherapy in the abdomen. Technical concepts will include incorporation of multi-modality imaging for treatment planning, image guidance at treatment, and functional and anatomical adaption. Clinical concepts will include functional targeting, clinical goals, and toxicity risks.

**Sub-Events****RC722A IGRT and Anatomical Adaptation****Participants**

Kristy K. Brock, PhD, Ann Arbor, MI, (kkbrock@med.umich.edu) (*Presenter*) License agreement, RaySearch Laboratories AB;

**LEARNING OBJECTIVES**

1) Describe the processes necessary for the safe and accurate integration of multi-modality imaging for treatment planning. 2) Understand the role of image guidance for abdominal radiotherapy. 3) Illustrate methods to perform functional and anatomical adaptation in the abdomen.

**ABSTRACT**

The use of imaging and other biomarkers to increase the efficacy of treatment and decrease the risk of toxicity increased in the abdomen. Functional imaging and serum-based biomarkers can enable a more detailed understanding of the tumor, its characteristics, and early indications of its response to therapy. In addition, they can also be utilized to assess an individual patients risk for toxicity, enabling a personalize approach to radiotherapy. These advanced imaging techniques can be combined with anatomical information to generate high precision treatment plans which can be adapted over the course of treatment to account for identified uncertainties, changes, and deviations which may compromise the delivery of the intended treatment or identify the ability to re-optimize treatment to improve the therapeutic ration. In this session, technical and clinical concepts will be described to design and deliver personalized radiotherapy in the abdomen. Technical concepts will include incorporation of multi-modality imaging for treatment planning, image guidance at treatment, and functional and anatomical adaption. Clinical concepts will include functional targeting, clinical goals, and toxicity risks.

**RC722B Functional Targeting, Clinical Goals, and Toxicity Risks****Participants**

Joseph M. Herman, MD, MSc, Baltimore , MD (*Presenter*) Consultant, Merrimack Pharmaceuticals, Inc

**LEARNING OBJECTIVES**

1) Review methods to obtain, process and analyze tissue and serum based biomarkers for abdominal tumors. 2) Describe current dose/fractionation regimens as well as normal tissue constraints utilized in treating abdominal tumors. 3) Explain potential advantages of assessing treatment response with MRI and quantitative PET/SPECT (PERCIST) imaging over CT based response (RECIST) in abdominal tumors.

**ABSTRACT**

In order to deliver personalized radiation therapy in abdominal tumors, it is important to understand the methods used to obtain, analyze, and interpret serum and tissue based biomarkers. Most research to date has focused on identifying specific biomarkers used to personalize systemic or targeted therapies. Radiation-specific biomarkers are emerging and may eventually be used to determine whether radiation is indicated or identify specific radiation sensitizers for use in abdominal tumors. Radiation therapy planning has historically used computed tomography (CT)-based imaging. Molecular imaging using hybrid positron emission tomography (PET)/CT scanning or single-photon emission computed tomography (SPECT) imaging and functional magnetic resonance imaging (MRI) has provided new insights into the precise identification of gross tumor volume (GTV) and clinical tumor volume (CTV) and has provided response information during and after therapy. The effective use of PET/SPECT and MRI in clinical practice, however, requires an appreciation of the unique challenges inherent to these modalities. Fundamental physical issues of limited spatial resolution relative to the biological process, partial volume effects, image misregistration, motion management, and edge delineation must be carefully considered and can differ by agent or the method applied. Integration of PET/SPECT and MRI imaging into multicenter clinical trials and clinical practice can be particularly challenging due to differences in imaging protocols, machines, and anatomy. Imaging protocols that clearly outline scan and fusion parameters are crucial. Further, interpretation of tumor response should be standardized, and scans should be obtained at consistent time intervals. In addition, it is important to consider novel tracers of tumor biology (e.g. hypoxia, proliferation, apoptosis) beyond the commonly used radiotracers. In this

session, we will discuss these applications and challenges as well as provide guidance on how to integrate PET/SPECT/MRI into radiation treatment planning and assessing treatment response. Finally, we will evaluate common dose and fractionation regimens as well as established dose constraints used in treating abdominal tumors with conventional and stereotactic body radiation therapy.-

RC724

## Near Misses and Errors in Diagnostic Radiology and Radiation Oncology: What to Do Next?

Thursday, Dec. 3 4:30PM - 6:00PM Location: S403B



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

### Participants

Mahadevappa Mahesh, MS, PhD, Baltimore, MD (*Moderator*) Author with royalties, Wolters Kluwer nv

### ABSTRACT

Radiation incidents in diagnostic radiology and radiation oncology is never a favorite item for anyone. Many a times, a single error or miss may lead to devastating result and can shine media spotlight. The purpose of this refresher course is to address this issue from various skate-holders. The course includes a tag-team of physicians-physicists addressing what one needs to next after a radiation incident occurs. The main objective of this refresher course is to provide ways audience can implement in their settings to address such events.

### Sub-Events

#### RC724A Radiation Incidents in Diagnostic Radiology: What Does the Physicist Do Next?

### Participants

Mahadevappa Mahesh, MS, PhD, Baltimore, MD, (mmahesh@jhmi.edu) (*Presenter*) Author with royalties, Wolters Kluwer nv

### LEARNING OBJECTIVES

1) To examine settings to ensure radiation incidents do not occur. 2) To develop plan of action for post radiation incident evaluation. 3) To reflect on processes such as quality control, training etc.

### ABSTRACT

Even though radiation incidents in diagnostic radiology may not be as life threatening as in radiation oncology, yet it is equally important to devise plans of action to address radiation incidents in diagnostic radiology. This talk will discuss various measures medical physicists can do to address such situations. Defining radiation incidents in diagnostic imaging settings are key. Radiation incidents can lead to deterministic effects such as hair-loss or skin erythema, which are rare but possible due to prolonged fluoroscopy procedures or CT scans (CT perfusion studies) due to incorrect settings. Even though prevention is better and is achievable by routine review of equipment and protocol settings, but when radiation incidents occur, a physicist can do the following. First, physicist should record details of scan settings that have led to the radiation incident. Next, it is important to assess and make necessary changes to the scan settings to avoid future incidents. This should be followed by detail assessment of radiation exposure to patients (skin dose and organ dose) and work with the radiologists and other physicians to address the radiation events. In addition, tasks including regulatory compliance, staff training, and others will be discussed in this talk.

#### RC724B Radiation Incidents in Radiation Oncology: What Does the Physicist Do Next?

### Participants

Eric Ford, PhD, Seattle, WA, (eford@uw.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Appreciate the systems-based approach to addressing the underlying causes of incidents. 2) Understand the medical physicist's specific role in this. 3) Gain familiarity with emerging error reduction tools in radiation oncology.

### ABSTRACT

Incidents in healthcare are a symptom of an underlying condition. In order to improve the quality and safety of care one must address these underlying conditions and not just the particulars of an incident itself. What is the physicist's role in this? In its simplest form, the medical physicist in radiation oncology performs quality assurance tests and commissioning procedures to ensure that the next incident does not happen. These tasks are often prescriptive in nature. As a quality management expert, though, the medical physicist's contribution extends far beyond these routine duties into the realm of understanding and controlling clinical process at the broadest level. There is an array of emerging tools from the AAPM and elsewhere that enable this. It is now possible, for example, to characterize and quantify the risks associated with clinical processes. It is also possible to benchmark performance in safety-critical area against other clinics. And it is possible to participate in incident investigation and learning through the newly released national incident learning system. All of these activities are core competencies of a medical physicist in radiation oncology in the modern era. By leading and participating in such efforts the medical physicist has a direct impact on improving the quality and safety of care.

#### RC724C Radiation Incidents in Diagnostic Radiology: What Does the Diagnostic Radiologist Do Next?

### Participants

Kimberly E. Applegate, MD, MS, Zionsville, IN, (keapple@emory.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To describe common incidents and their root cause in diagnostic radiology departments where patients are exposed to unintended radiation doses. 2) Understand both qualitative and quantitative metrics in a radiology safety program. 3) Provide examples of quality assurance and improvement projects based on a safety event and that promote a culture of safety.

## **ABSTRACT**

Safety is necessary but not sufficient to ensure quality healthcare. Radiology departments and healthcare systems must be in alignment with their programs on safety culture, policies, and practice to best minimize patient harm. When events happen-and they will-it is critical to understand how to disclose them, how to learn from them, and how to improve processes so that future patients in the system may not be harmed. Further, it is important that the culture of the radiology department embraces learning from near misses that provide the opportunity to improve practice before a patient is harmed. This lecture will share stories that led to quality improvement projects.

## **RC724D Radiation Incidents in Radiation Oncology: What Does the Radiation Oncologist Do Next?**

### Participants

Naomi R. Schechter, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose

### **LEARNING OBJECTIVES**

1) Describe strategies for responding to variety of potential near misses and errors in radiation oncology department as pertains to individual patient care. 2) Describe strategies for learning from near misses and errors in radiation oncology department for purpose of quality improvement and prevention of future errors.

### **ABSTRACT**

In a radiation oncology department, incidents can range from minor to severe. We take them all seriously. Due to our many checks and balances, it is unusual for an error to reach the patient. In the rare case that an error does reach the patient, most can be corrected for, with minimal if any harm to the patient. Our goal is to learn from every incident, review our processes and continually improve the delivery of radiation therapy to prevent future errors from occurring.

RC725

## Radiomics Mini-Course: From Image to Radiomics

Thursday, Dec. 3 4:30PM - 6:00PM Location: S404AB



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

### Participants

Sandy Napel, PhD, Stanford, CA (*Director*) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc

### Sub-Events

#### RC725A Image Annotation and Semantic Labeling

### Participants

Daniel L. Rubin, MD, MS, Palo Alto, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To understand the new Big Data paradigm in Radiology and learn about new tools that can help Radiologists to leverage images more effectively. 2) To become acquainted with the Annotation and Image Markup (AIM) format that makes image metadata (radiologist observations and quantitative image features) machine-accessible. 3) To learn how AIM can support radiology clinical workflow, enable research discovery, support regulatory objectives, facilitate new biomarker development, and improve clinical practice.

### ABSTRACT

The Annotation and Image Markup (AIM) format for collecting and storing measurements and other information in images brings tremendous benefits to clinical radiology. AIM standardizes image annotations, making the semantic descriptors and quantitative information in images machine-accessible, searchable, and minable. AIM allows more specific and customizable searching of annotations, enabling objective and computable analysis of measurements, and helps clinicians to more easily leverage images in a variety of application such as automated reporting, report summaries, lesion tracking, content based image retrieval, and decision support. AIM also enables trials that collect image measurements, and it facilitates integrating image data with non-image data, such as molecular and clinical data. Finally, by standardizing measurement data and permitting aggregating image annotations across multiple sites, AIM will 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. AIM currently underlies an interconnected suite of tools that allows researchers to easily generate minable structured image metadata for research, and it is being used in several national projects and at a variety of institutions nationally. URLs:(a) <https://wiki.nci.nih.gov/display/AIM/Annotation+and+Image+Markup+-+AIM>(b) <http://epad.stanford.edu>

### Honored Educators

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Daniel L. Rubin, MD, MS - 2012 Honored Educator  
Daniel L. Rubin, MD, MS - 2013 Honored Educator

#### RC725B Image Feature Computation and Considerations

### Participants

Sandy Napel, PhD, Stanford, CA (*Presenter*) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc

### LEARNING OBJECTIVES

1) Learn about processing pipelines that extract features from regions within images. 2) Learn about different classes of features. 3) Learn about feature interactions and influence of segmentation.

### ABSTRACT

Images can be two-dimensional (2D), 3D, time varying, and/or vector valued (when, e.g., multiple acquisitions of the same volume are acquired). Computation of features from images requires delineation (also called segmentation) of regions or volumes within these multidimensional images, and then applying computer algorithms to the data within these regions to characterize them and, perhaps, their surroundings, with numbers. This session will cover the structure of feature computation pipelines and various factors that influence their outputs. Classes of features include shape (values characterize region boundary smoothness and compactness), margin (values characterize how sharp the transition is from inside to outside the region), and texture (variation of gray values or color within and possibly nearby to the region). In addition, specialized features may be computed when prior research has described important implications of observations (e.g., %-ground glass opacities in lung nodules at CT). It is important to recognize that computed features may be influenced by data acquisition and reconstruction methods (e.g., sharp vs. smooth reconstruction kernels in CT, contrast agent on board, variation in pulse sequences across vendors), aspects of the region they are not designed to characterize (e.g., shape influenced by texture causing segmentation irregularities, histogram statistics influenced by nearby structures (e.g., bone within the segmentation of a lung nodule near a rib). Attention to these details can result in improved utility of extracted features, and more significance in associations of features with other clinical variables.

## RC725C Correlating Image Features with Multi-Omics Data

### Participants

Olivier Gevaert, PhD, Stanford, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

- 1) Understand how to model the relationship between image features and genomic data using univariate and multivariate methods.
- 2) Implement dedicated preprocessing for image feature data and for genomic data, each requiring their own statistical modeling.

### ABSTRACT

Vast amounts of molecular data characterizing the genome, epi-genome and transcriptome are becoming available for a wide range of cancers. In addition, new computational tools for quantitatively analyzing medical and pathological images are creating new types of phenotypic data. Now we have the opportunity to integrate the data at molecular and tissue scale to create a more comprehensive view of key biological processes underlying cancer. Moreover, this integration can have profound contributions toward predicting diagnosis and treatment. I will discuss current work in progress to model multi-omics data and how to integrate it with medical imaging data. I will show examples for non-small cell lung cancer and glioblastoma.



RCB55

## Making the Most of Google Docs: Docs, Slides, Forms, and Sheets (Hands-on)

Thursday, Dec. 3 4:30PM - 6:00PM Location: S401CD

IN

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

### Participants

Marc D. Kohli, MD, San Francisco, CA (*Moderator*) Research Grant, Siemens AG  
Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Research Grant, Siemens AG  
Ross W. Filice, MD, Washington, DC, (ross.w.filice@gunet.georgetown.edu) (*Presenter*) Nothing to Disclose  
Aaron P. Kamer, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose  
Andrew B. Lemmon, MD, Atlanta, GA (*Presenter*) Nothing to Disclose  
Thomas W. Loehfelm, MD, PhD, Atlanta, GA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe the benefits and drawbacks of using Google tools for collaborative editing. 2) Explain issues related to storing protected health information in Google Drive. 3) Demonstrate the ability to use the Google productivity applications for collaboration on document, spreadsheet, online form and presentation 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's suite of productivity applications provides a platform for collaboration that can be used across and within institutions to produce documents and presentations and to obtain and work-up data with ease. 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.

RC710

## Thyroid and Neck Ultrasound (An Interactive Session)

Thursday, Dec. 3 4:30PM - 6:00PM Location: S402AB



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

### Participants

### Sub-Events

#### RC710A Thyroid Nodules: When and What to Biopsy

### Participants

Jill E. Langer, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Discuss the sonographic characteristics that are associated with a high probability that a thyroid nodule is likely malignant or likely benign. 3) Gain an understanding of the rationale of the current guidelines for recommending thyroid fine needle aspiration.

### ABSTRACT

As an overview, this presentation will review the epidemiology of thyroid nodules and correlate the sonographic findings with the risk of malignancy or the likelihood that the appearance represents a benign hyperplastic thyroid nodule rather than a true neoplasm. Additionally, the rationale for current guidelines for recommending thyroid fine needle aspiration will be discussed. The prevalence of palpable thyroid nodules is estimated to be 6.4% in women and 1.5% in men between 30 to 60 years of age, living in iodine-sufficient regions. However, high resolution sonography of the neck has been shown to be a much more sensitive technique than palpation, detecting nodules in 19 to 67% of randomly selected adults, with detection rates greater in women and increasing with age for both genders. Fortunately the vast majority of sonographically detected thyroid nodules are benign, hyperplastic regions of the thyroid. Fine-needle aspiration biopsy (FNA) is still considered the most reliable diagnostic test to determine if a thyroid nodule is malignant. Malignant nodules account for approximately 5% of all nodules that undergo palpation-guided FNA and approximately 10 to 15% of nodules that undergo sonography-guided FNA procedures. Analysis of the sonographic features of thyroid nodules has become the preeminent non-invasive tool for analyzing the risk of malignancy of thyroid nodules and aids in selecting which nodules should undergo fine needle aspiration (FNA). A number of recently published guidelines and consensus statements emphasize that the sonographic appearance of a nodule is a superior predictor of malignancy compared with nodule size or palpability and that when sonographic features of malignancy are noted, the nodule should undergo FNA. A number of sonographic features have shown a high specificity for the diagnosis of thyroid cancer and include marked hypoechogenicity, the presence of microcalcifications, infiltrating or micro-lobulated borders, and a taller-

#### RC710B Post-Thyroidectomy Neck

### Participants

Carl C. Reading, MD, Rochester, MN (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Recognize the sonographic appearance of recurrent and metastatic disease, and other abnormalities, in the post-operative neck.

### ABSTRACT

In the post-thyroidectomy neck, ultrasound surveillance is a highly effective method to evaluate for residual and recurrent disease. Recurrence can occur anywhere within the neck, but typically is located in the mid and low internal jugular chains and thyroid bed region. Abnormal cervical lymph nodes can be recognized with a high degree of accuracy due to abnormal size, shape, internal architecture, and color Doppler appearance. In patients with suspected metastatic papillary cancer, the presence of internal fluid or calcifications is highly predictive of malignancy. Abnormal nodal color Doppler flow including peripheral (non-hilar), increased, and irregular flow is highly predictive of malignancy. Within the post-operative thyroid bed, itself, residual thyroid tissue, tumor recurrence, and suture granulomas can occur. FNA for cytologic analysis of suspected abnormalities can be performed, and the addition of thyroglobulin and calcitonin assay of the specimen, for papillary and medullary cancer, respectively, adds a high degree of accuracy to this procedure.

#### RC710C Parathyroid and Other Neck Masses

### Participants

Mary C. Frates, MD, Sharon, MA, (mfrates@partners.org) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify abnormal parathyroid glands based on sonographic characteristics 2) Develop an accurate differential for cystic lesions in the neck based on sonographic characteristics, lesion location and clinical circumstances. 3) List the most common etiologies of solid lesions located between the thyroid and the superior mediastinum.

### ABSTRACT

RC705

## Pediatric Neuroradiology

Thursday, Dec. 3 4:30PM - 6:00PM Location: N230



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

### Participants

Erin S. Schwartz, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Bruno P. Soares, MD, Atlanta, GA (*Moderator*) Nothing to Disclose

### Sub-Events

#### RC705A Imaging of the Developmentally Delayed Child

##### Participants

A. James Barkovich, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) How to properly protocol an MRI of the brain for developmental delay. 2) How the proper protocol depends on the age of the patient at the time of the scan. 3) Where to get information to help you to perform the best sequences ('developmental delay' is often not sufficient).

##### ABSTRACT

Developmental delay is a common indication for brain imaging in children, most commonly in the first few years of life. To be a useful study, the imaging examination must assess the brain for the most common causes of delayed development. These include malformations (genetic or acquired), injury from prior vascular event or infection (pre- or postnatal), inborn errors of metabolism and phakomatoses. Sometimes the presenting history will give a clue that helps to protocol the scan, but other times it is not until the first or second sequence is reviewed that the cause of the delay begins to become clear. This lecture will discuss: 1. The optimal imaging protocols for the diagnoses of these disorders 2. Clues from imaging as to the etiology of the brain abnormality 3. When additional sequences are necessary and how they should be performed The following structures must always be assessed in Developmentally Delayed patients: a. Midline structures: cerebral commissures, hypothalamus, pituitary gland, tectum, 4th ventricle, cerebellar vermis, brain stem. b. Cerebral Cortex: too thick (pachygyria), too thin (injury or insufficient neuron production/migration), too few sulci (oligogyria), too many sulci (if tiny, consider polymicrogyria). c. White matter: If too little white matter, consider a primary axonal disorder, either axonal navigation or axonal formation. If too much white matter (much less common) consider an overgrowth syndrome. If hypomyelinated, consider metabolic hypomyelination syndrome or delayed myelination due to illness or malnutrition. If damaged white matter, think of infection (usually asymmetric), inflammatory condition, or metabolic disorder (usually symmetric and often associated with symmetric deep gray matter, brain stem or cerebellar white matter damage). If heterotopic gray matter is present, think of in utero ependymal disruption or malformation syndrome. d. Midline Structures: Look for interhemispheric fissure; if gray matter crosses the midline from one hemisphere to the other, consider holoprosencephaly. If septum pellucidum is absent, look for gray matter crossing midline, look for optic nerve hypoplasia, ectopic posterior pituitary or small anterior pituitary (Septo-Optic Dysplasia); also look at the cerebellum for missing vermis (rhombencephalosynapsis), especially if hydrocephalus is present. Look at cerebral aqueduct. e. Posterior fossa: Make sure the cerebellum is completely formed, is of normal size compared to the cerebrum and that the vermis and hemisphere are proportional. Make sure all the lobules of the vermis are present. Look at the brain stem for proper proportions of the midbrain, pons and medulla.

#### RC705B Evidence-based Imaging of the Traumatized Pediatric Spine

##### Participants

Erin S. Schwartz, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) Be familiar with the current evidence regarding the value of radiographs, computer tomography, and magnetic resonance imaging in the evaluation of the traumatized pediatric spine. 2) Apply evidence-based imaging protocols to the evaluation of pediatric patients suspected of cervical spine trauma at your home institution.

##### ABSTRACT

Imaging of the traumatized pediatric spine has unique requirements due to the anatomy and injury patterns in the developing spine, susceptibility to soft tissue injury in the absence of fracture, and radiation dose sensitivity. Radiology Departments may be incorrectly applying imaging protocols developed for adult patients to "clear" their injured pediatric patients. Judicious use of radiographs, appropriately-dosed CT scanning, and MRI must be in the setting of a dedicated clinical protocol for the evaluation of the pediatric cervical spine. We will review the current literature on pediatric cervical spine trauma and the clinical/radiological pathway currently being implemented at The Children's Hospital of Philadelphia.

#### RC705C A Pattern-based Approach to Pediatric Metabolic Disease

##### Participants

Thierry Huisman, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) Become familiar with frequent and less frequent metabolic diseases that may injure the neonatal brain. 2) How to approach the imaging findings using a pattern recognition approach.

## **ABSTRACT**

Neuroimaging pattern recognition in white matter disorders was initiated by Marjo van der Knaap and Jaap Valk, a pediatric neurologist and a pediatric neuroradiologist, and first published in 1991. This approach not only simplified and guided the diagnosis of many gray and white matter disorders, but also made it possible to cluster patients with identical or similar MR patterns, allowing further clinical, laboratory, genetic and molecular exploration. Multiple, initially unknown or unclassified disease entities could consequently be identified along this track. In the current lecture the pattern recognition approach will be discussed and applied in a variety of pediatric metabolic disorders to demonstrate its value in facilitating the correct diagnosis of inherited white and gray matter diseases. In addition, we will discuss why various patterns of neuroimaging findings are best explained.

RC703

## Imaging for Catheter Based Cardiac Intervention (TAVR, EP Procedures, Mitral Procedures)

Thursday, Dec. 3 4:30PM - 6:00PM Location: N229



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

### Participants

### Sub-Events

#### RC703A Mitral Valve Interventions

### Participants

Philipp Blanke, MD, Vancouver, BC, (phil.blanke@gmail.com) (*Presenter*) Consultant, Edwards Lifesciences Corporation ; Consultant, Neovasc Inc

### LEARNING OBJECTIVES

1) To review the anatomy and normal appearance of the mitral apparatus on cardiac CT. 2) To review common mitral valve pathologies including mitral annular calcifications, myxomatous degeneration, mitral valve prolapse and mitral stenosis and their appearance on cardiac CT. 3) To learn about recent advances in transcatheter mitral valve interventions and the role of preoperative computed-tomography.

### ABSTRACT

1. To review the anatomy and normal appearance of the mitral apparatus on cardiac CT. 2. To review common mitral valve pathologies including mitral annular calcifications, myxomatous degeneration, mitral valve prolapse and mitral stenosis and their appearance on cardiac CT. 3. To learn about recent advances in transcatheter mitral valve interventions and the role of preoperative computed-tomography.

#### RC703B The Role of Imaging prior to TAVR

### Participants

Jonathon A. Leipsic, MD, Vancouver, BC (*Presenter*) Speakers Bureau, General Electric Company Speakers Bureau, Edwards Lifesciences Corporation Consultant, Heartflow, Inc Consultant, Circle Cardiovascular Imaging Inc

### LEARNING OBJECTIVES

1) Discuss the historical role of CTA in TAVR planning. 2) Review more recent data defining new applications for CT in TAVR planning. 3) Help define the potential future applications and role of MDCT in the future with new devices being introduced into the field.

### Honored Educators

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Jonathon A. Leipsic, MD - 2015 Honored Educator

#### RC703C Imaging to Inform Electrophysiology (EP) and Other Interventions

### Participants

Eric E. Williamson, MD, Rochester, MN, (Williamson.eric@mayo.edu ) (*Presenter*) Research Grant, General Electric Company

### LEARNING OBJECTIVES

1) Discuss the use of CT for preprocedure planning and postprocedure follow-up of electrophysiology (EP) interventions. 2) Describe expected and important unexpected findings on preprocedure CT used to guide EP intervention. 3) Describe common and uncommon complications of EP intervention as seen on postprocedure CT.

### ABSTRACT

1. Discuss the use of CT for preprocedure planning and postprocedure follow-up of electrophysiology (EP) interventions. 2. Describe expected and important unexpected findings on preprocedure CT used to guide EP intervention. 3. Describe common and uncommon complications of EP intervention as seen on postprocedure CT.

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

Thursday, Dec. 3 4:30PM - 6:00PM Location: N226

HP

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

### Participants

David A. Rosman, MD, Boston, MA (*Coordinator*) Nothing to Disclose

David A. Rosman, MD, Boston, MA (*Moderator*) Nothing to Disclose

Danny Hughes, PhD, Reston, VA, (dhughes@neimanhpi.org) (*Presenter*) Nothing to Disclose

Woojin Kim, MD, Philadelphia, PA, (woojinrad@gmail.com) (*Presenter*) Co-founder, Montage Healthcare Solutions, Inc; Shareholder, Montage Healthcare Solutions, Inc; Board of Directors, Montage Healthcare Solutions, Inc; Advisory Board, Zebra Medical Vision Ltd

### LEARNING OBJECTIVES

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

### ABSTRACT

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

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Woojin Kim, MD - 2012 Honored Educator

RC707

## GU Ultrasound 2015: The Expert's Update on Kidney, Gynecologic and Testicular US

Thursday, Dec. 3 4:30PM - 6:00PM Location: N227



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

### Participants

John J. Cronan, MD, Providence, RI (*Coordinator*) Nothing to Disclose

Mindy M. Horrow, MD, Philadelphia, PA, (horrowm@einstein.edu) (*Presenter*) Spouse, Director, Merck & Co, Inc

Paula J. Woodward, MD, Salt Lake City, UT (*Presenter*) Vice President, Reed Elsevier

### 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.

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Mindy M. Horrow, MD - 2013 Honored Educator

RC715

## Digital Breast Tomosynthesis

Thursday, Dec. 3 4:30PM - 6:00PM Location: N228



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

### Participants

### Sub-Events

#### RC715A Basics and Implementation

### Participants

Liane E. Philpotts, MD, New Haven, CT (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Define the essential steps involved in initiating tomosynthesis into practice. 2) Identify the key elements needed to implement tomosynthesis including educating patients and referring providers, marketing, and reimbursement issues. 3) Discuss performance issues such as interpretation time, learning curve, and workflow with tomosynthesis. 4) Anticipate changes in practice over time as a result of tomosynthesis, including fewer patients requiring follow up (BIRADS 3) and improved PPVs for biopsy recommendations, which may lead to changes in staffing or equipment needs.

### ABSTRACT

Initiating tomosynthesis into practice requires some important considerations. These include training requirements for technologists and radiologists, equipment needs, workstation essentials, PACS storage and retrieval, dose considerations and scheduling. Educating patients and physicians is important to permit weighing benefits versus increased dose. Marketing can be an important factor for some practices looking to increase services and volumes. Coding is now available and reimbursement issues will be considered. Changes in workflow can be profound and unanticipated initially. In addition to reduced recalls from screening, fewer patients will require close diagnostic follow-up therefore diminishing the diagnostic pool over time. Diagnostic exams are also streamlined, all leading to expediting the imaging workflow of patients. This can lead to changes in total equipment or staffing needs. Overall there is a net benefit as more patients will need less imaging and get more accurate reads.

#### RC715B Clinical Utility of DBT

### Participants

Stamatia V. Destounis, MD, Scottsville, NY (*Presenter*) Research Grant, FUJIFILM Holdings Corporation; Research Grant, Hologic, Inc; Research Grant, QT Ultrasound LLC

### LEARNING OBJECTIVES

1) Principles of Digital Breast tomosynthesis (DBT). 2) Initial implementation of DBT in a clinical practice and living in a hybrid Full Field Digital Mammography (FFDM) and Digital Breast Tomosynthesis (DBT) environment. 3) Initial training and education of physicians and technologists within the practice and changes in workflow. 4) Education of patients and referring health care providers. 5) Financial concerns with initiation and implementation of DBT. 6) Synthetic view implementation and reimbursement changes.

### ABSTRACT

Review of basic principles of Digital Breast Tomosynthesis and clinical benefits. Review of current literature on clinical implementation of Digital Breast Tomosynthesis. Outlining how a facility may embark on DBT implementation in a private practice setting. The costs and shortcomings of utilizing two modalities Full Field Digital and Digital Breast Tomosynthesis daily as the facility/department transitions from one modality to another. Educating your team of the changes that will be implemented is extremely important. The need for strong leadership from your technologists on required education and training, requirements of strong IT and PACS support, the issues and costs of archiving and storage of the large DBT files will be reviewed. Education of referring health care providers and the patients on the new technology is key to making a successful transition to a new modality. Marketing in the community through presentations, brochures and the facility's website will bring awareness and help implementation initiation and acceptance. Review of the synthetic view and its importance in answering radiation concerns. Recent reimbursement approval and its meaning in the clinical practice.

#### RC715C Challenging Cases

### Participants

Catherine M. Appleton, MD, Saint Louis, MO (*Presenter*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;

### LEARNING OBJECTIVES

1) List appropriate clinical applications of digital Breast tomosynthesis using a cases based approach. 2) Review problem solving techniques to resolve challenging findings in screening and diagnostic digital Breast tomosynthesis cases. 3) Recognize common pitfalls in digital breast tomosynthesis using a case based approach.

### ABSTRACT

Using an enriched case set, common findings encountered using DBT in the screening and clinical settings will be reviewed - to include challenging diagnostic findings, calcifications, pitfalls, and multi modality correlation.



RC753

## Computer Aided Diagnosis (Development and Clinical Applications)

Thursday, Dec. 3 4:30PM - 6:00PM Location: E350

**BR CT OI IN**

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

**FDA** Discussions may include off-label uses.

### Participants

Emanuele Neri, MD, Pisa, Italy (*Moderator*) Nothing to Disclose  
Hiroyuki Yoshida, PhD, Boston, MA (*Moderator*) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

### LEARNING OBJECTIVES

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

### ABSTRACT

Computer-aided diagnosis (CAD) has become one of the major topics in medical imaging and diagnostic radiology. In this refresher course, the principles of CAD will be presented, together with current developments as well as clinical applications of CAD. CAD aims at improving radiologists' diagnostic accuracy, and it can be used as primary, concurrent, or second reader. In principle, the CAD performs a morphological recognition of the pathology (nodule, focal lesion, polyp, etc.) combined with quantitative information (MR signal intensity, CT density, contrast enhancement, volume, etc.) Many different types of CAD schemes have been developed for detection and/or characterization of various lesions in different imaging modalities, including conventional projection radiography, CT, MRI, and ultrasound imaging. Organs that are subjected to research for CAD include the breast, lung, colon, brain, liver, kidney, and the vascular and skeletal systems. For detection of breast cancer on mammograms, more than 10,000 commercial CAD systems have been used clinically in assisting radiologists worldwide. For detection of lung cancer, CAD schemes have been developed for detection of pulmonary nodules on chest radiographs and CT images. In addition, CAD schemes have been developed for differential diagnosis of distinction between malignant and benign lesions. For colon cancer, CAD schemes have been developed for detection of polyps in CT colonography. Observer performance studies with use of ROC analysis indicated an improved performance in radiologists' task for detection and/or classification of these lesions.

### URL

### Sub-Events

#### RC753A Development of a CAD: From Benchtop to Clinic

### Participants

Ronald M. Summers, MD, PhD, Bethesda, MD, (rms@nih.gov) (*Presenter*) Royalties, iCAD, Inc; Research funded, iCAD, Inc;

### LEARNING OBJECTIVES

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

### ABSTRACT

#### RC753B CAD for CT Colonography: Where Do We Stand?

### Participants

Daniele Regge, MD, Candiolo, Italy, (daniele.regge@ircc.it) (*Presenter*) Speakers Bureau, General Electric Company

### LEARNING OBJECTIVES

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

#### RC753C CAD for Breast Cancer Detection: Where Do We Stand?

### Participants

Ulrich Bick, MD, Berlin, Germany, (Ulrich.Bick@charite.de) (*Presenter*) Equipment support, Hologic, Inc; License agreement, Hologic, Inc; Royalties, Hologic, Inc; Equipment support, Toshiba Corporation; Institutional research collaboration, Siemens AG

### LEARNING OBJECTIVES

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

## RC753D CAD for Lung Cancer Detection: Where Do We Stand?

### Participants

Kunio Doi, PhD, Chicago, IL, (k-doi@uchicago.edu) (*Presenter*) Shareholder, Hologic, Inc; License agreement, Hologic, Inc; License agreement, Deus Technologies, LLC; License agreement, Riverain Technologies, LLC; License agreement, Mitsubishi Corporation; License agreement, MEDIAN Technologies; License agreement, General Electric Company; License agreement, Toshiba Corporation; Research support, Deus Technologies, LLC; Research support, E. I. du Pont de Nemours & Company; Research support, Elcint Medical Imaging Ltd; Research support, FUJIFILM Holdings Corporation; Research support, General Electric Company; Research support, Hitachi, Ltd; Research support, Eastman Kodak Company; Research support, Konica Minolta Group; Research support, Mitaya Manufacturing Co, Ltd; Research support, Mitsubishi Corporation; Research support, Koninklijke Philips NV; Research support, Hologic, Inc; Research support, Riverain Technologies, LLC; Research support, Seiko Corporation; Research support, Siemens AG; Research support, 3M Company; Research support, Toshiba Corporation

### LEARNING OBJECTIVES

View learning objectives under main course title.

### ABSTRACT

RC709

## Biliary - Potpourri (An Interactive Session)

Thursday, Dec. 3 4:30PM - 6:00PM Location: E353B

GI

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

### Participants

### Sub-Events

#### RC709A Cholangiocarcinoma

### Participants

Kartik S. Jhaveri, MD, Toronto, ON (*Presenter*) Speaker, Bayer AG

### LEARNING OBJECTIVES

1) Review Diagnosis and Mimics of Cholangiocarcinoma. 2) Discuss Classification and Imaging Appearances of Cholangiocarcinoma. 3) Highlight Role of Imaging in Staging and Resectability Evaluation of Cholangiocarcinoma.

### ABSTRACT

#### RC709B Benign Biliary Disease

### Participants

Ivan Pedrosa, MD, Dallas, TX (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Demonstrate the MRI findings in common and uncommon benign biliary disease. 2) Convey available MRI techniques and protocols for evaluation of benign biliary disease. 3) Illustrate common pitfalls that can mimic benign biliary disease.

### Active Handout:Ivan Pedrosa

[http://abstract.rsna.org/uploads/2015/15001887/RC709B\\_Pedrosa\\_20m.pdf](http://abstract.rsna.org/uploads/2015/15001887/RC709B_Pedrosa_20m.pdf)

#### RC709C Biliary Post-op Complications

### Participants

Chandana G. Lall, MD, Orange, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand underlying mechanism of iatrogenic biliary injury. 2) Review of biliary anatomy: Anatomic variants which may predispose to injury. 3) MR Imaging features of iatrogenic biliary injury. 4) Classification of biliary injuries. 5) Role of hepatobiliary agents in workup of biliary injury.

### ABSTRACT

Surgical procedures and underlying mechanism for iatrogenic biliary injury Biliary anatomy: Anatomic variants which may predispose to injury Imaging features of iatrogenic biliary injury on MR Imaging Classification system in assessing biliary injuries Role of hepatobiliary agents

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Chandana G. Lall, MD - 2013 Honored Educator

#### RC709D Biliary Cases I Missed

### Participants

John P. McGahan, MD, Sacramento, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To familiarize the audience with common imaging pitfalls when evaluating the biliary system. 2) To help the audience avoid common mistakes when evaluating the biliary tract with either MRI or CT. 3) To demonstrate to the audience what devastating consequences that may occur when suggesting a specific wrong diagnosis.

RC721

## Medical Physics 2.0: Information Management and Display

Thursday, Dec. 3 4:30PM - 6:00PM Location: E353A

PH IN

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

### Participants

Ehsan Samei, PhD, Durham, NC (*Director*) Nothing to Disclose  
Douglas E. Pfeiffer, MS, Boulder, CO (*Director*) Nothing to Disclose

### Sub-Events

#### RC721A Information Management and Display Perspective

### Participants

Ehsan Samei, PhD, Durham, NC (*Presenter*) Nothing to Disclose

### 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.

#### RC721B Information Management and Display 1.0

### Participants

Donald Peck, PhD, Detroit, MI (*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. Vendor 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.

#### RC721C Information Management and Display 2.0

### Participants

Michael J. Flynn, PhD, Detroit, MI (*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.

RC723

## MR Safety II

Thursday, Dec. 3 4:30PM - 6:00PM Location: E352

**MR** **PH** **SQ**

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

**FDA** Discussions may include off-label uses.

### Participants

Matthew A. Bernstein, PhD, Rochester, MN (*Director*) Research collaboration, General Electric Company

### LEARNING OBJECTIVES

1) Classify MR conditional pacemakers, and describe guidelines for their clinical usage in the MR environment. 2) List several MR Safety incidents and describe their root causes. 3) Describe special MR Safety hazards present in the interventional MR environment, and identify countermeasures to reduce the associated risks. 4) Implement preventive measures for MR Safety in a clinical practice to improve the standard of care.

### ABSTRACT

#### Sub-Events

#### **RC723A MRI Conditional Pacemakers, What to Do?**

#### Participants

Anshuman Panda, PhD, Phoenix, AZ (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### **RC723B Case Review of Real MR Safety Incidents**

#### Participants

Armen Kocharian, PhD, Houston, TX, (akocharian@houstonmethodist.org) (*Presenter*) Research collaboration, General Electric Company

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### **Active Handout:Armen Kocharian**

[http://abstract.rsna.org/uploads/2015/15002852/RC723B Case Review of Real MR Safety Incidents \(1\).pdf](http://abstract.rsna.org/uploads/2015/15002852/RC723B Case Review of Real MR Safety Incidents (1).pdf)

#### **RC723C MRI Safety in the MR-Guided Interventional Environment**

#### Participants

Krzysztof Gorny, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

RC713

## Pediatric Fetal (An Interactive Session)

Thursday, Dec. 3 4:30PM - 6:00PM Location: E351



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

### Participants

#### LEARNING OBJECTIVES

Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

### Sub-Events

#### RC713A Fetal Ear and Orbital Anomalies

##### Participants

Maria A. Calvo-Garcia, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Identify major fetal external ear and orbital malformations. 2) Apply useful search patterns during US and fetal MRI evaluation of external ear and orbital anomalies.

#### ABSTRACT

Assessment of the fetal face is an important part of the sonographic structural survey. Craniofacial abnormalities occur as an isolated phenomenon or in the context of syndromes, chromosomal abnormalities or environmental insults. Along the course of this presentation we will review the standard facial anatomic survey with US and the main embryologic steps involved in the development of the face. Subsequently we will discuss major malformations involving the external ear and orbits and their expected association. The presentation will include clinical cases evaluated with US and fetal MRI and their postnatal correlations.

#### RC713B Fetal Chest Anomalies

##### Participants

Teresa Victoria, MD, PhD, Philadelphia, PA, (victoria@email.chop.edu) (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) To discuss the most common fetal lung masses. 2) To identify imaging algorithms and patterns that can be helpful in reaching a diagnosis.

#### ABSTRACT

Accurate diagnosis of fetal lung lesions is crucial for appropriate counseling and management of the abnormalities in hand. During the lecture, the normal appearance of the fetal chest will be briefly done, in order to approach a review of the most common pulmonary lesions encountered during the fetal period. Diagnostic clues that will guide accurate diagnosis will be discussed. Rare lung lesions and their imaging diagnostic approach will also be discussed.

#### RC713C Fetal GI Anomalies

##### Participants

Erika Rubesova, MD, Stanford, CA (*Presenter*) Researcher, Siemens AG

#### LEARNING OBJECTIVES

1) After the presentation, the learners should be able to recognize the normal appearance of developing fetal bowel, as well as the most common and uncommon presentations of congenital bowel anomalies on ultrasound and MRI. They will become familiar with the specific information provided by each of the two modalities. The course will present a review of bowel anomalies of the fetus and will be illustrated by representative cases with the objective for the learners to understand the systematic approach of image analysis that can lead to the accurate diagnosis or limited list of differential diagnoses.

#### ABSTRACT

Diagnosis of fetal bowel anomalies usually presents on ultrasound as bowel dilatation or echogenic bowel. Echogenic bowel is associated with multiple other congenital conditions such as chromosomal anomalies, viral infections or cystic fibrosis. Dilatation of bowel may have various etiologies and systematic review of the findings including bowel wall thickening, number of distended bowel loops or the increased echogenicity of the content may help to localize bowel obstruction and narrow the list of differential diagnosis. Fetal MRI adds precious information to the ultrasound thanks the larger field of view, better tissue contrast but mainly thanks to high T1 signal intensity of meconium. Meconium is formed in the entire bowel and accumulates in the rectum that acts as a reservoir. While meconium is seen in the small bowel and colon in the second trimester, it is mainly seen in the fetal colon after 30 weeks of gestational age. Meconium acts as intraluminal contrast, similar to a barium enema. Systematic review of the distribution of meconium and analysis of the bowel caliber in comparison to normal values for gestational age helps to establish or narrow the list of differential diagnoses of fetal gastrointestinal abnormalities. In this presentation, we will review the advantages and limitations of ultrasound and MRI for diagnosis of fetal anomalies, we will discuss and illustrate, by representative cases, the approach to the most common and some more rare or atypical congenital bowel anomalies on ultrasound and MRI, in order to establish a single or short list of differential diagnoses.

**Handout:Erika Rubesova**

[http://abstract.rsna.org/uploads/2015/15002067/Rubesova GI RSNA 2015.pptx](http://abstract.rsna.org/uploads/2015/15002067/Rubesova_GI_RSNA_2015.pptx)

RC751

## Pitfalls in Liver Imaging

Thursday, Dec. 3 4:30PM - 6:00PM Location: E451B



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

### Participants

#### 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

#### Sub-Events

### RC751A Pitfalls in Liver Imaging

#### Participants

Khaled M. Elsayes, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.

#### Honored Educators

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Khaled M. Elsayes, MD - 2014 Honored Educator

### RC751B Pitfalls in Liver Imaging: Cirrhosis

#### Participants

Richard L. Baron, MD, Chicago, IL, ([rbaron@uchicago.edu](mailto:rbaron@uchicago.edu)) (*Presenter*) Speakers Bureau, Bracco Group

#### LEARNING OBJECTIVES

View learning objectives under main course title.

### RC751C Pitfalls in MR of the Liver: Technique and Contrast Agents

#### Participants

Janio Szklaruk, MD, PhD, Bala Cynwyd, PA (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

View learning objectives under main course title.



RC729

## Updates in Pancreatic Imaging: Spotlight on MRI (An Interactive Session)

Thursday, Dec. 3 4:30PM - 6:00PM Location: E451A



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

### Participants

#### LEARNING OBJECTIVES

Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

### Sub-Events

#### RC729A Systematic Approach to Pancreatic Cancer

##### Participants

Elizabeth M. Hecht, MD, New York, NY, (eh2560@cumc.columbia.edu) (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Discuss a systematic approach to diagnosing and staging pancreatic cancer and discuss template reporting for preoperative planning. 2) Discuss potential mimics and pitfalls related to diagnosis and staging of solid pancreatic neoplasms

#### ABSTRACT

Treatment of pancreas cancer requires a multidisciplinary approach. Imaging interpretation and reports play a critical role in managing patients with pancreatic pathology. Accurate staging of pancreatic neoplasms is paramount to determining management and imaging plays a central role in stratifying patients for treatment. The goal of surgery is to achieve resection margins free of tumor to maximize survival benefit. Unnecessary surgery and accompanying morbidity need be minimized in patients with no added survival benefit from resection. Structured reporting and standardized terminology enhances communication with the clinic team and imparts key elements into a diagnostic report that will help determine appropriate management.

**Active Handout:** Elizabeth M. Hecht

[http://abstract.rsna.org/uploads/2015/15002793/Active RC729A.pdf](http://abstract.rsna.org/uploads/2015/15002793/Active_RC729A.pdf)

#### RC729B Pancreatic Cyst: A Multidisciplinary Approach to Diagnosis and Management

##### Participants

Ihab R. Kamel, MD, PhD, Baltimore, MD (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Describe the imaging features of pancreatic cysts and the impact of multidisciplinary approach to diagnosis and management.

#### ABSTRACT

##### Honored Educators

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Ihab R. Kamel, MD, PhD - 2015 Honored Educator

#### RC729C The Inflamed Pancreas: Pearls and Perils

##### Participants

Koenraad J. Mortelee, MD, Boston, MA (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) To review the imaging features of a vast array of inflammatory conditions that may involve the pancreas.

RC701

## Thoracic MR: Ready for Prime Time!

Thursday, Dec. 3 4:30PM - 6:00PM Location: E353C

CH MR

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

### Participants

Jeanne B. Ackman, MD, Boston, MA (*Moderator*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To learn what it takes to build a thoracic MR practice. 2) To understand how to create simple mediastinal, pleural, lung, and pulmonary MRA protocols which answer most clinical questions. 3) To become more comfortable interpreting these various types of thoracic MRI.

### ABSTRACT

Despite MRI's long-demonstrated advantages in tissue contrast and diagnostic specificity and its absence of radiation, MRI remains an underutilized imaging modality in the thorax. The aim of this course is to cover the basics needed to build a thoracic MR practice and to perform and interpret thoracic MRI, whether of the thymus, the rest of the mediastinum, the pleura, or the lung. Fast and robust examination protocols, applicable and ready to use on currently available MR equipment, will be suggested. Clinical indications for thoracic MRI and commonly encountered lesions will be discussed. Performance and interpretation of pulmonary MRA for pulmonary embolism detection will also be covered.

### Sub-Events

#### RC701A Non-Vascular Thoracic MRI: Building a Clinical Program

### Participants

Jeanne B. Ackman, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

To understand the challenges, multifaceted approach, and benefit of building a clinical non-vascular thoracic MR practice.

### ABSTRACT

There are many challenges to building a clinical non-vascular thoracic MR practice, many of which can be surmounted by: 1) identifying a knowledgeable and capable radiologist within your practice to take this initiative and build a team of interested colleagues to move forward 2) educating technologists, referring physicians, trainees, and colleagues as to its performance, interpretation, and benefits, 3) building a few simple MR protocols which can answer most clinical questions, 4) regularly sharing MR cases to enhance the knowledge of your group, 5) patience and recognition of the fact that those in your group insufficiently trained in thoracic MRI may not at first be comfortable with protocoling, interpreting, and recommending these examinations; these colleagues will need to be convinced of MR's benefits and, if interested, will be open to learning what they need to learn to maximize the benefits that can be achieved for patient care as a result of MR's higher tissue contrast, diagnostic specificity, and lack of ionizing radiation.

#### RC701B Basic Thymic MRI

### Participants

Jeanne B. Ackman, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

The attendee will learn about basic Thymic MR protocoling and interpretation which will help distinguish: 1) Thymic cysts from solid thymic lesions. 2) Normal thymus and thymic hyperplasia from thymic tumors. 3) Low-risk thymomas from high-risk thymomas and lymphoma. 4) Invasive from non-invasive thymic masses.

### ABSTRACT

It can be difficult by CT to distinguish between thymic cysts and solid lesions, thymic hyperplasia from thymic tumors, and thymoma from lymphoma. The purpose of this brief lecture is to cover the basics of thymic MR protocoling and interpretation in an effort to achieve these objectives and prevent unnecessary thymectomy.

#### RC701C Practical Mediastinal and Pleural Imaging

### Participants

Constantine A. Raptis, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Discuss the key components of an MRI protocol tailored to investigate mediastinal pathology. 2) Review the imaging findings of commonly seen mediastinal pathologies which can be characterized with MRI. 3) Identify sequences which can be helpful in investigating pleural abnormalities. 4) Explore the MRI appearance of pleural fluid collections and soft tissue lesions.

### ABSTRACT

#### RC701D MRI of the Lung: Why...When...How?

Participants

Juergen Biederer, MD, Gross-Gerau, Germany, (biederer@radiologie-darmstadt.de ) (*Presenter*) Nothing to Disclose

#### **LEARNING OBJECTIVES**

1) to provide basic protocol suggestions for clinical lung MRI and 2) to make familiar with variations of this protocol for typical questions such as parenchymal, vascular or malignant diseases of the lung.

#### **ABSTRACT**

Frequently, customized lung imaging protocols are already available with the MR equipment. If not, setting up a protocol tree for lung imaging with MRI is straightforward using standard sequences for different pathologies: T2-w. fast spin echo (FSE) for infiltrates/soft lesions (1), T2-w. FSE with fat suppression for lymph nodes/bone lesions (2), Steady state free precession (SSFP) for respiratory motion/lung vasculature (3) and T1-w. 3D gradient echo (3D-GRE) for nodules/masses and airways (4). Optional sequences comprise MR angiography, dynamic contrast enhancement (DCE) for lung/tumor perfusion and diffusion weighted imaging (DWI) for lymph nodes/lesion characterization. The examination times range from 15' (standard) to 25' (all options).

#### **RC701E     How to Perform and Interpret Pulmonary MRA**

Participants

Mark L. Schiebler, MD, Madison, WI (*Presenter*) Nothing to Disclose

#### **LEARNING OBJECTIVES**

1) Protocol a pulmonary MRA exam. 2) Determine what GBCA to use. 3) Problem solve common pulmonary MRA artifacts. 4) Correctly interpret Pulmonary MRA exams.

**Active Handout: Mark L. Schiebler**

<http://abstract.rsna.org/uploads/2015/15001935/RC701E.pdf>

RC708

## Imaging of the Extremities (An Interactive Session)

Thursday, Dec. 3 4:30PM - 6:00PM Location: E450B



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

### Participants

#### LEARNING OBJECTIVES

Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

### Sub-Events

#### RC708A Orthopedic Hardware: All You Wanted to Know

### Participants

Manickam Kumaravel, MD, FRCR, Houston, TX, (Manickam.Kumaravel@uth.tmc.edu) (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Recognize the various types of orthopedic hardware in musculoskeletal imaging practice. 2) Understand the functionality of orthopedic hardware. 3) Identify the adequate positioning of hardware 4) Diagnose malpositioning and complications of hardware placement and guide treatment.

#### ABSTRACT

Radiologists are routinely faced with images containing orthopedic hardware. Appropriate recognition of various types of hardware is crucial for the continuation of patient care. The lecture will explain the functionality of orthopedic hardware. Illustrations of the appearance of orthopedic hardware will be made with cartoons, radiographs and Computed Tomography (CT). The attendee will be educated about identification of type of hardware; adequacy of hardware and emphasis will also be placed on diagnosis, complications and malposition of common orthopedic hardware. Guidance will also be provided with regard to appropriate report formulation.

#### RC708B Ankle and Foot

### Participants

Ken F. Linnau, MD, MS, Seattle, WA, (klinnau@uw.edu ) (*Presenter*) Speaker, Siemens AG; Royalties, Cambridge University Press;

#### LEARNING OBJECTIVES

1) To identify clinical scenarios which may require advanced foot and ankle imaging in the emergency department in addition to radiography. 2) To select appropriate imaging modality and exam parameters for advanced foot and ankle imaging on CT, MR and sonography. 3) To identify radiographic, CT, MR and ultrasound findings of complex or subtle foot and ankle injuries in order to aid in efficient clinical decision making and treatment planning.

#### ABSTRACT

The foot and ankle are very commonly injured in extremity trauma. Radiographs are the most common initial imaging study for evaluation of foot and ankle injuries. Unfortunately, radiography can be of limited utility for complete assessment of the bones and soft tissues of the foot and ankle. As a result advanced imaging, including CT, MRI or sonography may be helpful to fully characterize injuries and aid in treatment decision making. The purpose of this interactive presentation is to highlight injuries and clinical settings which may require expedited advanced imaging of the foot and ankle in addition to radiography while the patient is still in the emergency room.

#### RC708C Pelvis

### Participants

Bharti Khurana, MD, Boston, MA (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Understand the key factors that contribute to pelvic stability. 2) Recognize the patterns of osseous and soft-tissue injuries in pelvic fractures.

#### ABSTRACT

Treating trauma patients with displaced pelvic fractures requires a multidisciplinary approach at a designated trauma center to reduce morbidity and mortality. Immediate recognition of pelvic ring disruption and determination of pelvic stability are critical components in the evaluation of such patients. Stability is achieved by the ability of the osseoligamentous structures of the pelvis to withstand physiologic stresses without abnormal deformation. The supporting pelvic ligaments, including the posterior and anterior sacroiliac, iliolumbar, sacrospinous, and sacrotuberous ligaments, play a crucial role in pelvic stabilization. Radiologists should be familiar with the ligamentous anatomy and biomechanics relevant to understanding pelvic ring disruptions, as well as the Young and Burgess classification system, a systematic approach for interpreting pelvic ring disruptions and assessing stability on the basis of fundamental force vectors that create predictable patterns. This system provides an algorithmic approach to interpreting images and categorizes injuries as anteroposterior (AP) compression, lateral compression, vertical shear, or combined. Opening and closing of the pelvis from rotational forces result in AP compression and lateral compression injuries, respectively,

whereas vertical shear injuries result from cephalad displacement of the hemipelvis. AP and lateral compression fractures are divided into types 1, 2, and 3, with increasing degrees of severity. Knowledge of these injury patterns leads to prompt identification and diagnosis of other subtle injuries and associated complications at pelvic radiography and cross-sectional imaging, allowing the orthopedic surgeon to apply corrective forces for prompt pelvic stabilization

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Bharti Khurana, MD - 2014 Honored Educator

RC706

## The Temporal Bone: Anatomy, Inflammation and Tumors

Thursday, Dec. 3 4:30PM - 6:00PM Location: E450A



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

### Participants

### Sub-Events

#### RC706A Temporal Bone Imaging: Anatomy

##### Participants

John I. Lane, MD, Rochester, MN, (lane.john@mayo.edu) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) The learner will be able to easily identify the clinically relevant anatomic structures of the temporal bone after completing the course. 2) The learner will have a better appreciation of the orientation of the auditory ossicles and the benefits of multiplanar oblique reconstructions from MDCT datasets for demonstrating normal ossicular anatomy and pathology. 3) The learner will have a better appreciation of the normal and pathologic appearance of the cochlea, vestibule, semicircular canals, and vestibular aqueduct on high resolution CT and MR.

#### RC706B Temporal Bone Imaging: Inflammation

##### Participants

Joel D. Swartz, MD, Gladwyne, PA (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) The learner will be able to understand and analyze the most common varieties of inflammation involving the external auditory canal, middle ear, mastoid and inner ear. 2) The learner will understand the appropriate use of computed tomography and MRI. 3) The learner will be able to differentiate cholesteatoma from other middle ear maladies and understand the pathophysiology of the entities discussed in the presentation. 4) The learner will understand the imaging approach to inner ear inflammation.

##### ABSTRACT

This presentation will follow an anatomically organized template. The external ear entities emphasized will include necrotizing external otitis, keratosis obturans, granulation tissue and EAC cholesteatoma. There will be special attention to middle ear cholesteatoma with a discussion of diffusion weighted imaging and differentiation of this lesion of granulation tissue and cholesterol granuloma. The pathophysiology of labyrinthitis will also be emphasized.

#### RC706C Temporal Bone Imaging: Tumor

##### Participants

Amy F. Juliano, MD, Boston, MA, (amy\_juliano@meei.harvard.edu) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) Understand temporal bone anatomy and identify the various portions of the temporal bone. 2) Know the most common neoplasms that occur in different areas of the temporal bone, and recognize their imaging characteristics. 3) Know the differential diagnosis of tumors in the temporal bone region by location and imaging appearance.

##### ABSTRACT

Temporal bone neoplasms are overall not very common. It is useful to think of the temporal bone in terms of its various subsites, as the tumors that may be found in each subsite is different, and being able to localize an imaging finding to a particular subsite greatly aids in establishing a differential diagnosis. When there are classic imaging features, one can even quite easily arrive at the specific diagnosis. The subsites to be discussed are: the internal auditory canal/cerebellopontine angle cistern, middle ear cavity, mastoid, external auditory canal, petrous apex, and the facial nerve.