

## AUR 2010 Research Paper Abstracts

Research paper presentations are 8 minutes in length, followed by a 2-minute discussion period. Presenting author is identified by institution name, city, and state (or country if not United States or Canada). Presentations by trainees (residents, medical students, or first-year fellows) are noted in blue.

**Thursday, March 25, 2010**  
**10:30 AM–12:00 PM**

### **SS01: Scientific Session 1** **Clinical Imaging I (Women's Imaging and Interventional Radiology)**

**Location: Sapphire Ballroom A**

**Moderators: Janie M. Lee, MD, MS**  
**TBD**

VI

#### **(SS01-01) 10:30 AM** **Multimodality Breast Lesion Localization: Mathematical Relationships with Respect to Breast Size and Tissue Compliance**

Sheela D. Konda, MD, PhD, *Munster, IN*; Deepa Popuri, MD, BS; Ellen B. Mendelson, MD\*

**PURPOSE:** Accurate localization and identification of a breast lesion on various imaging modalities can challenge radiologists due to variations in patient position. Our specific aim is to establish easily measurable parameters for each modality and derive a mathematical relationship that can be used clinically to confirm lesion identity.

**METHOD AND MATERIALS:** In this retrospective study, we reviewed 101 breast lesions seen on mammography (MG), US, and MRI exams performed between 1/2005 and 8/2009. The 97 patients (age range, 29–89 years) had palpable or nonpalpable benign and malignant masses. The distances from the anterior aspect of the lesion to the pectoralis muscle and from the anterior aspect of the lesion to the skin were measured with all three modalities. Parameters were analyzed with respect to breast density and overall breast size. Statistical tests used were analysis of variance and two-sample *t* test using Excel software.

**RESULTS:** Breast lesions included in the study had a size range of 1.0–6.4 cm (mean, 2.1 cm  $\pm$  .87). 96% of masses were malignant, and 4% were benign. As expected, the lesion is closest to the pectoralis muscle in US, given superior patient positioning. On US, the lesion is approximately 3.29 ( $\pm$ 1.75) times ( $P < .001$ ) closer to the pectoralis compared to MG and approximately 3.08 ( $\pm$ 1.64) times ( $P < .001$ ) closer to the pectoralis compared to MRI. The lesion-to-pectoralis muscle distance is not significantly different when comparing MG and MRI ( $P > .05$ ). Lesion-to-pectoralis muscle distance is affected by breast size in all three modalities ( $P < .05$ ), but lesion-to-skin distance is not ( $P > .05$ ). Lesion on US is approximately 6.42 ( $\pm$ 4.05) times ( $P < .001$ ) closer to the skin compared to MG and approximately 5.25 ( $\pm$ 3.54) times ( $P < .001$ ) closer to the skin compared to MRI. Lesion-to-pectoralis muscle and lesion-to-skin distances are not affected by breast density ( $P > .05$ ).

**CONCLUSION:** Our results demonstrate that lesion-to-skin distance is the most reliable parameter for confirming a lesion on MG, US, and MRI, since it is not affected by breast size or density. Application of these mathematical relationships will provide for more-confident correlation, which is crucial during diagnosis and management.

#### **(SS01-02) 10:40 AM** **Prediction of Benignity of Solid Adnexal Masses**

Shengfu Wang, MD, PhD, *Wayne State University-Detroit Medical Center, Detroit, MI*; Samuel C. Johnson, MD (swang@med.wayne.edu)

**PURPOSE:** To identify the sonographic features of benign solid ovarian tumors and to determine whether these tumors may be managed conservatively.

**METHOD AND MATERIALS:** Sixty-three patients from September 1999 to September 2008 with solid adnexal masses with no or minimal cystic component or Doppler vascularity and acoustic attenuation were retrospectively reviewed. Twenty patients without pathology results or follow-up studies were excluded. The remaining 43 patients had follow-up

imaging studies and/or surgical treatment. The median age of the study group was 52 years (range, 16–80 years).

**RESULTS:** Twenty-nine patients with solid adnexal masses were managed nonsurgically. Their age range was 26–80 years (median, 56). The size of the masses ranged from 0.7 to 8.3 cm (median, 2.2). The follow-up time ranged from 3 to 76 months (median, 30). Nineteen masses (65.5%) showed no change on the follow-up exam. Two masses showed an increase in size (6.9%), and eight masses (27.6%) showed a decrease in size or complete resolution. These masses all had well-circumscribed margins, were homogeneous, with increased attenuation, and had no or minimal vascular flow or cystic component. Normal ovarian tissue was detected in all of the masses. These patients exhibited no subsequent evidence of malignancy such as development of metastases, local invasion, or ascites. Fourteen patients with solid adnexal masses underwent surgical treatment. Their age range was 16–72 years (median, 40). The size of the excised masses ranged from 1.8 to 12.3 cm (median, 3.2). Normal ovarian tissue was sonographically demonstrated in only four of these masses (29%). All 14 patients (100%) had benign results at pathology. Four patients showed no ovarian neoplasm. Ten patients had benign ovarian neoplasms, including four fibromas, three fibrothecomas, one Brenner's tumor, one granulosa cell tumor, and one teratoma.

**CONCLUSION:** We present a retrospective study of both surgical and nonsurgical management of solid ovarian masses. None of the sonographically diagnosed benign-appearing solid adnexal masses were subsequently proved to be malignant either at pathology or by clinical course, suggesting that ultrasound can accurately predict benignity in these masses.

#### **(SS01-03) 10:50 AM** **Outcomes of Requesting Prior Mammograms in Mobile Telemammography**

Michyla L. Bowerson, BS, *University of Michigan Medical School, Ann Arbor, MI*; Chintana Paramagul; Mark A. Helvie, MD\*; Marilyn A. Roubidoux, MD (mbowerso@med.umich.edu)

**PURPOSE:** The Indian Health Service (IHS), an agency in the Department of Health and Human Services, implemented a telemammography unit (Mobile Women's Health Unit) to serve North and South Dakota, using digital mammography with satellite transmission to an academic medical center for interpretation. Our purpose was to determine outcomes related to requesting prior mammograms. Patients served are located among 18 different clinics, and patients' prior mammograms were commonly not immediately available for comparison.

**METHOD AND MATERIALS:** We retrospectively reviewed BI-RADS 0 reports in which prior mammograms were requested, among 13 radiologists reading 966 mammograms. The reasons, incidence, time, costs, and BI-RADS outcomes associated with prior mammogram requests were measured or estimated. Prior mammograms were obtained either as original films by mail or as digitized transmission of original films. Costs were extrapolated from a 1996 publication, calculated at \$28.40 per patient in 2007.

**RESULTS:** 177 (18.3%) prior mammograms were requested. Specific abnormalities were described in 61.4%, most commonly density, asymmetry, calcifications, or mass. No abnormality was described in 38.6%. The mean proportion of prior mammogram requests by an individual radiologist was 26.7% (range, 5.5%–46%). 168 prior mammograms were obtained; eight were never received. When the prior was obtained, 19% were recalled for additional imaging, 75.6% were interpreted as negative or benign (BI-RADS 1 or 2), 3.6% were recommended for required short-term follow-up (BI-RADS 3), and 2.4% were recommended for biopsy (BI-RADS 4), of which one was proven to be malignant. When a prior mammogram was not obtained, 50% were recalled, 25% were negative or benign, 25% required short-term follow-up, and zero required biopsy. The average time to obtain the prior mammogram is 31 days (range, 0–141 days). Estimated cost for obtaining prior mammograms in the group was \$4771.

**CONCLUSION:** Obtaining prior mammograms decreases recall rate and short-term follow-up. Cost for detection of malignancy is reasonable, although cancer detection rate is low (0.6%), ie, similar to the prevalence

\* Faculty financial disclosures are located in the Faculty Index.

of cancer in screening populations (3–10/1000). Radiologists' rates of requesting prior mammograms varied widely.

#### (SS01-04) 11:00 AM Specimen Quality of Vacuum-assisted and Spring-loaded Breast Biopsy Devices in a Breast Parenchymal Model

Rakhi Goel, MD, *University of Maryland Medical Center, Baltimore, MD*; Cristina I. Campassi, MD; Angela Darko, MD (rgoel@umm.edu)

**PURPOSE:** To compare nine breast biopsy devices in terms of specimen weight and fragmentation by using turkey breast as a human breast model.

**METHOD AND MATERIALS:** We evaluated seven vacuum-assisted devices (Suros Atec 9G Standard, Suros Atec 12G Standard [Hologic], Vacora 14G, Vacora 10G [Bard], Mammotome 11G, Mammotome 8G, and Mammotome EX 11G [Ethicon]), one spring-loaded device (Monopty 14G [Bard]), and one combined vacuum-assisted and spring-loaded device (Suros Celero 12G). Two board-certified radiologists who specialized in breast imaging collected 100 specimens per device, using whole turkey breasts at room temperature. Specimens were immediately measured by a pathologist for weight, length, diameter, and fragment number. Volume was derived using the formula,  $V = \pi * r^2 * l$ .

**RESULTS:** Measured specimen weight correlated well with volume, so that for every milligram increase in weight, the volume increased 1.22 mm<sup>3</sup> (95% confidence limit from 1.18 to 1.25;  $P < .0001$ ). The mean specimen weight was higher when using larger needles; in particular, the weight was greatest for the vacuum-assisted Mammotome 8G device (240 mg) and smallest for the spring-loaded vacuum-assisted Suros Celero 12G device (37 mg). Overall, the mean specimen weight differed significantly among the nine devices ( $P < .00001$  by ANOVA). In pairwise analyses, all weight comparisons were significantly different, with the exception of Suros Atec 9G versus Vacora 10G ( $P = .448$ ), and Mammotome 8G versus Vacora 10G ( $P = .090$ ), which yielded specimens of similar weight. The specimen fragmentation was mild in most of the cases: single core in 686 of 900 (76.4%), and two fragments in 186 specimens (20.6%). Twenty-six specimens (2.8%) were in three fragments, and only one (0.11%) was in four fragments.

**CONCLUSION:** Breast biopsy devices differ significantly in specimen yield, with more-consistent results obtained when using the larger vacuum-assisted 8–10G devices. Specimen quality, in addition to lesion characteristics, type of imaging guidance, and pathology expertise, should influence the selection of a biopsy device. Devices that deliver an ample sample allow more exact diagnosis, and further investigation is needed to determine specific effects upon ease of histologic evaluation and patient outcome.

#### (SS01-05) 11:10 AM Soft-Tissue Cryotherapy: Initial Experience and Intermediate Follow-up in Retroperitoneal, Intraperitoneal, Superficial, and Bone Locations

Hyun J. Bang, MD, *Wayne State University, Detroit, MI*; Peter J. Littrup

**PURPOSE:** To assess complications, recurrences, and resorption with soft-tissue cryotherapy for retroperitoneal, intraperitoneal, superficial, and bone locations.

**METHOD AND MATERIALS:** 157 CT- and/or US-guided percutaneous cryotherapy procedures were performed (retroperitoneal = 30, intraperitoneal = 51, superficial = 47, and bone = 29) in 97 patients. Protection of adjacent crucial tissues (eg, skin, bowel) from cytotoxic temperatures (eg,  $\leq 20^{\circ}\text{C}$ ) was achieved by thermocouple monitoring, saline injection, and/or direct skin warming. Complications were graded according to Common Toxicity Criteria for Adverse Events (CTCAE), version 3.0. Patients were followed by CT or MRI, and local recurrence was defined as any asymmetric nodular enhancement of the cryozone and/or ablation site enlargement. Resorption was calculated from ablation zone measurements at 1, 3, 6, 12, 18, and 24+ months.

**RESULTS:** The cryotherapy zone was well defined by CT as a hypodense ice ball with an average ablation diameter of 5.4 cm, while average tumor diameter was 3.5 cm. Major complications (CTCAE grade  $> 3$ ) occurred in seven patients (4%). After an average follow-up of 14 months (range, 0.25–79), a total of 23 recurrences (15%) were noted, of which eight (35%) abutted and 15 (65%) were satellite lesions (5–10 mm beyond ablation zone). A 2:1 ratio of distant to local recurrence suggested good local cancer control for difficult patients. By 24 months, there was a total volume reduction of 77.2%.

**CONCLUSION:** Percutaneous soft-tissue cryotherapy is a well-tolerated treatment alternative, especially for patients with anesthesia risks or painful lesions or for those seeking local control during chemotherapy. Tumor size and/or location do not preclude thorough treatment or pose greater risk with appropriate precautions.

#### (SS01-06) 11:20 AM Incidence of Sepsis and Cholangitis Following Percutaneous Transhepatic Biliary Catheter Cholangiography and Exchange

Daniel T. Ginat, MD, MS; Wael Saad, MD; Wade C. Hedegard, MD, *University of Rochester, Rochester, NY*; Mark G. Davies; David L. Waldman, MD, PhD; Takashi Kitanosono

**PURPOSE:** Percutaneous transhepatic cholangiography and tube exchanges are commonly performed on a routine basis in patients with long-term biliary catheters. However, the complication rates related to these procedures have not been well characterized. The goal of this study is to establish the incidence of cholangitis and sepsis after routine percutaneous biliary drainage catheter check and change and to determine whether liver transplant patients are at a greater risk for these complications.

**METHOD AND MATERIALS:** A retrospective review of 154 consecutive patients (100 liver transplants and 54 native livers) who underwent a total of 910 cholangiograms and biliary exchanges (January 2005 to July 2008) was performed. These procedures were performed every 4–6 weeks. Two-tailed  $t$  test was used to determine the statistical significance of differences in the MELD scores between the liver transplant and non-liver transplant patients. The two-tailed Fisher's exact test was used to determine the level of significance between the incidence rates of cholangitis and sepsis for the two cohorts. A  $P$  value of less than .05 was considered to be statistically significant.

**RESULTS:** Patients with liver transplants were significantly younger (54 vs 67 years), were predominantly male (70% vs 52%), and had worse liver disease (12.2 vs 8.0 MELD) than those without. The overall incidence of cholangitis and sepsis after biliary tube exchanges was 2.1% and 0.4%, respectively. There was no statistically significant difference in the incidence of the complications between patients with and without liver transplants. Patients with complications after biliary tube exchange were admitted for observation and supportive treatment for 2.4 nights on average. None required intensive care.

**CONCLUSION:** Routine biliary drainage catheter exchange is a safe procedure. There is no increased complication rate among liver transplant patients. Hospitalization for postprocedure complications is generally brief.

#### (SS01-07) 11:30 AM Complication Rates and Outcomes of 536 Implanted Subcutaneous Chest Ports: Do Rates Differ Based on the Primary Operator's Level of Training?

Kiley D. Perrich, MD; Anne M. Silas, MD, *Dartmouth-Hitchcock Medical Center, Lebanon, NH*; Eric K. Hoffer, MD; Nancy J. McNulty, MD (Anne.M.Silas@hitchcock.org)

**PURPOSE:** Totally implanted subcutaneous central venous access devices are an attractive option for patients in need of intermittent recurrent venous access. In our department, these devices are placed by different operator types. The purpose of our study is to assess the rate of complications of subcutaneous venous port placement among the different operator types.

**METHOD AND MATERIALS:** Retrospective review of all subcutaneous central venous access devices implanted in patients in our department between 10/8/04 and 10/19/07 was undertaken. Total numbers of port days, overall complication rates for all operators, and complication rates for the various operator types were calculated and were compared using the  $\chi^2$  test.

**RESULTS:** During the period of study, 558 patients had totally implanted subcutaneous central venous access devices placed. Of these, 536 had documented follow-up and comprise the study population. A total of 39 complications (7.28%) occurred, including 27 infections (5%). There were no statistically significant differences in overall complication rates, including infection rates, among operator groups ( $P = .925$ ).

**CONCLUSION:** Our results confirm that well-trained physician extenders and trainees can safely perform chest port placement and that these providers, under appropriate supervision, can help provide improved access to chest port placement for patients and referring clinicians.

\* Faculty financial disclosures are located in the Faculty Index.

**(SS01-08) 11:40 AM****Improving Start-Time Delays for the First Case of the Day in Interventional Radiology: A Quality Improvement Project**

Erin Kinney, BS, *Emory University, Atlanta, GA*; Richard Wright; Habib Tannir; Hyun S. Kim, MD; Kimberly E. Applegate, MD, MS (kimberly.applegate@emoryhealthcare.org)

**PURPOSE:** Predictable work flow of an interventional radiology (IR) department is crucial to patient and IR team satisfaction, as well as efficient utilization of departmental resources. The purpose of this study is to measure start times, analyze causes of start-time delays for first cases, and identify and implement quality improvement interventions using a systems approach.

**METHOD AND MATERIALS:** At a university IR department, a flowchart was prepared to diagram the complex work process from time of transport request for inpatients or time of arrival at reception for outpatients to end of procedure. Ten time events were collected for each patient on four rooms' first-of-day cases. Ishikawa diagram of key causes of delays was based on pilot data and interviews with IR team members, including attendings, fellows, supervisors, RNs, technologists, and clerks. Data were zeroed to goal start time, averaged by day, and analyzed using run charts. Iterative interventions were performed by the IR service to improve start times.

**RESULTS:** Initial data showed delayed start times in nine of 11 days studied, with 5 days having a delay of 10 minutes or greater. Key causes identified were late arrival of patients to department, labs not drawn or results not available, and lack of standard process for obtaining consent. Interventions included point-of-care blood testing and scripting the process of consent. Repeat measurement of average start time improved after these interventions. The IR team noted perceived improvement in start times was linked to improved job satisfaction.

**CONCLUSION:** Delays in patient arrival, lack of lab data, and consent delays contribute most to late start times for first cases. These factors present an opportunity for quality improvement by standardizing outpatient prep procedure instructions, inpatient transport, and how providers are engaged to obtain consents. This improvement team was able to improve a process without added funding or resources.

**(SS01-09) 11:50 AM****Interventional Oncology Research: Slowing Growth, Limited Focus, and Inadequate Funding**

Daniel S. Chow, BS, *University of California, Los Angeles, Los Angeles, CA*; Michael W. Itagaki, MD (dschow@ucla.edu)

**PURPOSE:** To retrospectively examine the characteristics and trends of interventional oncology research.

**METHOD AND MATERIALS:** Interventional oncology articles published from 1996 to 2008 were identified in the National Library of Medicine's MEDLINE database. Country of origin, article methodology, and study topic were recorded. Growth was analyzed using linear and nonlinear regression, with  $P \leq .05$  for significance.

**RESULTS:** A total of 1887 journal articles were identified, of which 563 (29.8%) originated from the United States, 255 (13.5%) from Japan, and 174 (9.2%) from Italy. Global publications grew from four articles in 1996 to 317 in 2008 with a sigmoid pattern (predicted maximum, 298.5 articles/year;  $P < .001$ ). Growth for the United States was sigmoid (maximum, 75.2 articles/year;  $P < .001$ ) and was linear in Japan, Italy, and China (growth, 4.7 articles/year [ $P < .001$ ], 2.5 articles/year [ $P < .001$ ], and 3.3 articles/year [ $P < .001$ ], respectively). The U.S. fraction of world research shrank from 42.9% in 1998 to 24.6% in 2008. The United States produced twice as many review articles as clinical trials. Japan and China published 4.3 and 6.7 times as many clinical trials as review articles, respectively. Articles funded by the National Institutes of Health (NIH) numbered 63 (11.2% of U.S.). Liver cancer articles numbered 1093 (57.9%); kidney, 252 (13.4%); lung, 164 (8.7%); and colorectal, 123 (6.5%).

**CONCLUSION:** After a period of rapid growth, global publication growth in interventional oncology is slowing, raising questions about its sustainability. Interventional oncology research has focused heavily on liver cancer, with relatively little emphasis on other tumors. The United States focuses on review articles, and its relative contribution has steadily declined. Asian nations focus on clinical trials and exhibit steady growth. The NIH funding of U.S. interventional oncology research has been relatively poor.

**Thursday, March 25, 2010****10:30 AM–12:00 PM****SS02: Scientific Session 2****Clinical Imaging II (Musculoskeletal and Neuroradiology)****Location: Sapphire Ballroom D**

Moderators: Jon A. Jacobson, MD\*  
Douglas W. Fellows, MD

**(SS02-01) 10:30 AM****Gamma Knife Radiosurgery for Treatment of Paragangliomas: Clinical and Anatomical Outcomes**

Muhammad O. Afzal, MBBS, MD, *Memphis, TN* (omer467@hotmail.com)

**PURPOSE:** Paragangliomas are neoplasms of the head and neck that occur most commonly in the carotid body, jugulotympanic area, and vagal paraganglia. Traditionally, surgery and radiation therapy have been the preferred method of treatment. Recently, stereotactic radiotherapy, which employs a large dose of radiation delivered to a precisely defined area, has been used effectively to treat tumors while minimizing the amount of normal tissue in the treatment field. Treatment appears to be well tolerated, with no reported severe chronic toxicities. In our study, we evaluate (1) efficacy of gamma knife surgery (GKS); (2) clinical outcomes after GKS, involving worsening or improvement of symptoms; and (3) association of GKS with higher incidence of secondary malignancies.

**METHOD AND MATERIALS:** Sixteen subjects were enrolled. Data involving imaging (CT, MRI) and clinical signs and symptoms at presentation and after treatment were recorded. Using records of CT and MRI, comparisons were made to determine the tumor size and whether any complications or recurrence of tumor has occurred. Successful treatment is defined as tumor that remains stable or decreases in size after GKS. After initial data collection, interviews were done to determine long-term side effects of the GKS and the stability of the relief of symptoms provided by GKS.

**RESULTS:** Of the 16 patients, 12 had follow-up CT/MRI to evaluate tumor size and effectiveness of treatment. The mean follow-up time for imaging was 2 years. None of the patients demonstrated increase in size of the tumor, meeting the criteria for successful treatment. Three patients actually demonstrated decrease in size of the primary tumor. Phone interviews were conducted in 11 patients, with the mean follow-up time of 3.1 years. Thirty percent of patients had some symptom relief at 6 months, with 91% of patients having decreased symptoms at the time of interview; 72% of patients reported significant decrease. There were no secondary CNS malignancies. At the time of presentation, two of the questionnaires were not returned.

**CONCLUSION:** Gamma knife surgery is a safe and effective treatment for paragangliomas. In our limited patient pool, there were no secondary malignancies associated with GKS.

**(SS02-02) 10:40 AM****Evaluation of Gadoteridol versus Gadopentetate Dimeglumine for Contrast-enhanced MR Imaging in a Rat Brain Glioma Model at 1.5 and 3 T**

Jeremy D. Cannell, MD, *Scott and White Memorial Hospital-Texas A&M College of Medicine, Temple, TX*; Val M. Runge, MD\*; Fei Ai, MD; John N. Morelli, MD (jcannell@gwmail.sw.org)

**PURPOSE:** To compare gadoteridol (ProHance; Gd-HP-DO3A) and gadopentetate dimeglumine (Magnevist; Gd-DTPA) with respect to lesion enhancement in a rat brain glioma model at 1.5 and 3 T.

**METHOD AND MATERIALS:** Forty-two rat brains were injected with glioma cells and administered an equivalent dose (0.1 mmol/kg) of either Gd-HP-DO3A or Gd-DTPA. Animals were then imaged at either 1.5 or 3 T. Twenty-four hours later, each rat was injected with the alternate agent. Gd-HP-DO3A alone was evaluated comparing a standard dose at 1.5 T to half dose at 3 T and the standard dose at both field strengths. T1-weighted images were analyzed before and at five times after contrast with respect to lesion signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR), and contrast enhancement (CE).

**RESULTS:** Lesion SNR, CNR, and CE increased, respectively, between 54%–84%, 19%–30%, and 24%–35% with Gd-DTPA versus 63%–78%,

\* Faculty financial disclosures are located in the Faculty Index.

21%–27%, and 26%–33% with Gd-HP-DO3A over both 1.5 T and 3 T. There were no statistically significant differences in these parameters at any time point ( $.53 < P < .99$ ) at either field strength. Standard-dose Gd-HP-DO3A demonstrated significant improvements in SNR (13%–70% at 1.5 T and 25%–81% at 3 T;  $P < .001$ ) and CE (13.1%–20.5% at 1.5 T and 24.4%–40.5% at 3 T;  $P < .02$ ) at 3 T versus 1.5 T at every time after contrast. CNR results were similar ( $P < .03$ ) except at the 1-minute time point. No significant differences were found in the standard and half-dose Gd-HP-DO3A comparison in terms of CNR (16%–20% at 1.5 T and 12%–18% at 3 T;  $.11 < P < .76$ ) or CE (18.4%–22.3% at 1.5 T and 17.9%–23.9% at 3 T;  $.68 < P < .84$ ).

**CONCLUSION:** Lesion enhancement with Gd-DTPA and Gd-HP-DO3A is not significantly different in the rat brain glioma model at 1.5 or 3 T. Our experience with gadoteridol (internal quality assurance survey;  $n = 279$ ) shows rates of minor adverse reactions, such as nausea (1.8%), vomiting (0.4%), and hives (0%), in agreement with results from FDA clinical trials for Gd-DTPA. Also, no documented cases of nephrogenic systemic fibrosis (NSF) attributable to Gd-HP-DO3A exist worldwide. Thus, Gd-HP-DO3A may be a preferable choice for routine neuroimaging. The ability to image with half-dose Gd-HP-DO3A at 3 T without detriment to lesion enhancement allows further reduction in theoretical safety risk and potential cost savings.

### (SS02-03) 10:50 AM Dysembryoplastic Neuroepithelial Tumors: MR Imaging Characteristics and a Novel Way of Categorization

Jonathan K. Lee, BS, *Wayne State University, Detroit, MI*; Matthew S. Chan, MD; Imad Zak, MBBS (JOLEE@med.wayne.edu)

**PURPOSE:** Dysembryoplastic neuroepithelial tumors (DNETs) are rare benign neoplastic proliferations that cause intractable seizures. The purpose of this study was to categorize these tumors based on neuroimaging appearance.

**METHOD AND MATERIALS:** MR images in 30 patients with DNETs confirmed by histopathologic examination were retrospectively reviewed. The tumors were first characterized by their features on T1- and T2-weighted sequences, size, location, and whether they had any enhancement, bony remodeling, calcification, or hemorrhage. Based on neuroimaging appearance, the tumors were then categorized into four types.

**RESULTS:** All of our DNETs demonstrated T1 hypo- or isointensity, T2 hyperintensity, and no edema, mass effect, or diffusion restriction. There were 19 tumors in the temporal lobe, four in the frontal lobe, three in the parietal lobe, and four involving two or more adjacent lobes. There were seven tumors with enhancement, eight with bony remodeling, two with calcifications, and one with hemorrhage. There were 22 tumors on the left side and eight on the right. Size of the tumors varied from 6 mm to 5 cm. DNETs have varied imaging appearances. Although other studies have reported specific imaging features such as septations, pseudocysts, and ring signs, these were not consistently present in our cases. Instead, we focused on the tumor's general appearance rather than specific signs. We propose a novel way of categorizing these tumors, with four distinctive types: type I, solid; type II, solid with cystic components; type III, predominantly cystic; and type IV, predominantly infiltrative. With a total of 30 cases, using our categorization, there were 10 type II tumors, 10 type IV tumors, six type III tumors, and four type I tumors. These imaging types have unique differential diagnoses that may be considered. For example, when a suspected ganglioglioma is seen on neuroimaging, a type II DNET may also be considered in the differential.

**CONCLUSION:** By understanding the varied MRI appearances of DNETs, they can be more confidently included in the differential diagnosis for patients with cortical or subcortical tumors.

### (SS02-04) 11:00 AM Comparison of a Novel Readout-segmented Diffusion-weighted MR Sequence to Conventional Single-Shot EPI and BLADE at 1.5 and 3 T



John N. Morelli, MD, *Scott and White Memorial Hospital-Texas A&M Health Systems, Temple, TX*; Val M. Runge, MD\*; Thorsten Feiweier, MD\*; David Porter, PhD\*; Rajesh Rangaswamy, MD; Lan Vu, PhD; et al (dr.john.morelli@gmail.com)

**PURPOSE:** To evaluate a readout-segmented (rs-EPI) approach to diffusion-weighted imaging (DWI) utilizing a modified Stejskal-Tanner pulsing

scheme with respect to signal-to-noise ratio (SNR), susceptibility artifacts, image blur, and overall quality versus FSE BLADE (PROPELLER) and conventional single-shot EPI (ss-EPI) at 1.5 and 3 T.

**METHOD AND MATERIALS:** Eleven healthy volunteers underwent diffusion-weighted MR examinations at 1.5 and 3 T. DWI scans were obtained with ss-EPI, FSE with BLADE k-space sampling, and rs-EPI sequences with equal nominal spatial resolutions and similar acquisition times. Both EPI sequences utilized a modified Stejskal-Tanner approach for diffusion encoding. SNR was quantified in the pons and anterior forceps, as were pontine spatial distortions. A blinded reader ranked the scans in terms of high-signal-intensity bulk susceptibility artifact, resulting spatial distortions, image blur, and overall preference.

**RESULTS:** At 3 T, SNR at the level of the forceps was greatest with the rs-EPI sequence ( $5.4 \pm 0.1$ ;  $P < 10^{-6}$ ), second with ss-EPI ( $4.0 \pm 0.1$ ;  $P < 10^{-6}$ ), and least with BLADE ( $2.9 \pm 0.1$ ). Pontine SNR was similar. Quantified spatial distortions were greater with ss-EPI ( $0.2 \pm 0.03$ ;  $P < .001$ ) than with rs-EPI ( $0.1 \pm 0.02$ ) at 3 T. The blinded reader ranked the scans in terms of severity of bulk susceptibility artifact and spatial distortions as ss-EPI > rs-EPI > BLADE and in terms of image blurriness as BLADE > ss-EPI > rs-EPI. In terms of overall preference, BLADE was ranked first in every case, rs-EPI second, and ss-EPI last. Results were similar at 1.5 T.

**CONCLUSION:** Despite reductions in image blur and susceptibility artifacts versus ss-EPI, rs-EPI DWI remains overall less preferred to BLADE in volunteers, due to the lack of susceptibility artifacts in the latter. In practice, the low SNR of BLADE DWI may hinder detection of diffusion abnormalities and thus limit acceptability. The greater intrinsic SNR of rs-EPI combined with the modified Stejskal-Tanner pulsing scheme will allow for the future application of parallel imaging to further reduce susceptibility artifacts while maintaining true spatial resolution and SNR compared to the BLADE and conventional EPI scans.

#### AUR Trainee Prize: 3rd Place

### (SS02-05) 11:10 AM Additional Evaluation with MR Imaging after Tibial Plateau Fractures: When Is It Most Useful?

Mary N. Fontanella, MD, *University of Rochester, Rochester, NY*; David Tuttle, MD; Shaun Khosla, MD; Gregory Dieudonne, MD; John Gorczyca, MD; Johnny U. Monu, MD (mary\_fontanella@urmc.rochester.edu)

**PURPOSE:** MRI has been shown to be equally as useful as or more useful than CT in the evaluation of tibial plateau fractures. The very large number of patients with tibial plateau fractures precludes use of MRI in all cases for fracture evaluation. MRI will be more useful in the diagnosis of soft-tissue injuries that may not be diagnosed preoperatively. The purpose of our study is to determine which cases of tibial plateau fractures will benefit from additional imaging using MRI.

**METHOD AND MATERIALS:** From our radiology database, we identified cases of tibial plateau fractures that have had both CT and MRI. The severity of each fracture was estimated using CT-corrected Schatzker classification. The patients with types I and II were grouped as class 1 injuries, patients with type III and IV fractures were grouped as class 2 injuries, and types V and VI were grouped as class 3 injuries. The MRI was assessed for presence of soft-tissue injuries, including tears of the ACL and the PCL, injury to the lateral and medial collateral ligaments, tears of the menisci, and trapped meniscus. The soft-tissue injuries seen on MRI were then correlated with the class of fractures. Injury ratios (IRs) were calculated by dividing the number of soft-tissue injuries (STIs) in each group by the number of patients.

**RESULTS:** 443 exams for tibial fractures were performed over a 99-month period from January 2001 to March 2009. There were 38 (23 male, 15 female) patients aged between 14 and 88 years (mean, 42 years) who underwent both CT and MRI. Eighteen patients had very severe or class 3 fractures; 54% of the STIs were seen in this group. Nine patients had moderately severe or class 2 fractures, and 23% of the STIs were in this group. Eleven had class 1 fractures, with about 22% of the STIs. Twenty meniscal injuries were seen in 25 patients with Schatzker IV–VI fractures, yielding an IR of 80%. Ten meniscal injuries were seen in 20 patients with Schatzker I–IV fractures and an IR of 46%.

**CONCLUSION:** The largest numbers of soft-tissue injuries were seen in the higher grades of Schatzker injuries. Additional evaluation with MRI is likely to be more useful in patients with the higher grades of tibial plateau fractures (Schatzker grades IV–VI).

\* Faculty financial disclosures are located in the Faculty Index.

**(SS02-06) 11:20 AM****The “Medial Femoral Sulcus Sign”: Does It Exist?**

Robert D. Wissman, MD\*<sup>†</sup>; Daniel Hendry; Sangita Kapur, MD; Dan Gorman, MD, *University of Cincinnati, Cincinnati, OH*; Jerrell Ingalls, MD (Robert.Wissman@Healthall.com)

**PURPOSE:** An impaction injury of the lateral femoral sulcus, the “deep lateral notch sign,” is a known indicator of anterior cruciate ligament (ACL) disruption. Anecdotally, we have noted impaction of the medial femoral sulcus on magnetic resonance imaging (MRI) of the knee in patients with hyperextension injuries. The purpose of our study was to determine if a medial femoral sulcus deformity on plain film radiographs could indicate internal derangement of the knee.

**METHOD AND MATERIALS:** A retrospective search of MRI reports over a 5-year period was made, looking for the keyword “hyperextension.” An additional search over the same time period was made for all ACL and posterior cruciate ligament (PCL) tears noted on MRI of the knee. All MRI and plain film radiographs were reviewed for the presence of edema, impaction, and/or deformity of the medial femoral sulcus. The integrity of the cruciate and collateral ligaments was analyzed.

**RESULTS:** Twenty patients with edema and/or impaction of the medial femoral sulcus were identified by MRI examinations. The typical location for impaction was the superior portion of the medial femoral sulcus. Eighteen patients had plain film radiographs of the knee for comparison. Of these, only two patients (11%) had a plain film correlate with deformity at or near the terminal sulcus of the medial femoral condyle. Both patients had disruption of the ACL, PCL, and posterolateral corner structures.

**CONCLUSION:** The medial femoral sulcus sign does exist and is indicative of severe internal derangement of the knee, but this sign occurs with such rarity that its usefulness as a marker of internal derangement is limited.

**AUR Trainee Prize: 1st Place**

**(SS02-07) 11:30 AM****Windswept Appearance: A New Sign to Describe Subscapularis Tendon Tears**

Ameera F. Ismail, MD, *University of Iowa Hospitals, Iowa City, IA*; Lee Bennett, MD (lee-bennett@uiowa.edu)

**PURPOSE:** Previously reported sensitivities and specificities for subscapularis tendon tears are low. We are conducting this study to describe a new sign (windswept appearance) to help more accurately diagnose subscapularis tears.

**METHOD AND MATERIALS:** Shoulder MRIs (1.5 T) performed from January 2005 to December 2006 were retrospectively reviewed (396) for the windswept appearance of the subscapularis tendon by two observers who were blinded to the clinical history, surgical reports, and original MRI report. Exclusion criteria included (1) studies from external facilities, (2) MR arthrograms, (3) shoulder MRIs obtained for indications other than evaluation of the rotator cuff, (4) no surgical correlation present, and (5) patients with prior surgery. The medical records of the nonexcluded 211 patients were reviewed, and MRI findings by the reviewers were correlated to the surgical reports (open and arthroscopic).

**RESULTS:** Sixty-nine patients underwent surgery; 19 had subscapularis tendon tears. Twelve had the MRI windswept sign (three complete and nine partial tears). In seven of the partial tears, the windswept sign was not present on MRI. The calculated sensitivity of the windswept appearance sign for subscapularis tears (partial and complete) was 63%, with a specificity of 100%. The sign was 100% sensitive and 95% specific for complete tears and was 25% sensitive and 84% specific for partial tears.

**CONCLUSION:** The windswept appearance is highly sensitive and specific for complete subscapularis tendon tears. This windswept sign of the subscapularis tendon will help improve diagnosis of complete subscapularis tears and aid in management of these patients.

**(SS02-08) 11:40 AM****Accuracy of Percutaneous FDG PET/CT-guided Biopsy of Bone Lesions**

John J. Pan, MD, *Brigham and Women’s Hospital, Boston, MA*; Gregory Hurllock, MD; Nadereh Nasserhelali, MD, PhD (jjpan@partners.org)

**PURPOSE:** PET/CT imaging is used routinely to follow progression of disease or response to medical treatment in patients with a history of malignancy. FDG-avid but CT-occult bone lesions are suspicious for metastatic disease but are not amenable to percutaneous CT-guided biopsy. Pathologic

diagnosis is essential for accurate staging. The purpose of this study is to determine the accuracy of percutaneous FDG PET/CT-guided biopsy of FDG-avid but CT-occult bone lesions.

**METHOD AND MATERIALS:** We reviewed 11 consecutive patients with a history of primary malignancy who underwent FDG PET/CT-guided biopsy of suspected bone metastases that were FDG avid but not visible on CT. One patient had two suspicious lesions, which made a total of 12 biopsies in this study.

**RESULTS:** There were nine true positives, one false negative, and two true negatives, which resulted in an overall diagnostic accuracy of 91.6% (sensitivity = 0.9; specificity = 1.0; PPV = 1.0; NPV = 0.66).

**CONCLUSION:** FDG PET/CT-guided biopsy of bone lesions is a minimally invasive and accurate method for evaluation of suspected sites of metastasis that are FDG avid but not visible on CT.

**(SS02-09) 11:50 AM****Complications of Soft-Tissue Tumors after Treatment**

Lorraine G. Shapeero, MD, *Uniformed Services University of Health Sciences, Bethesda, MD*; Pieter J. De Visschere; Koenraad L. Verstraete; Bart Poffyn; Ramses Forsyth; Dirk Uttendaele

**PURPOSE:** To evaluate and relate complications of soft-tissue tumors to types of therapy.

**METHOD AND MATERIALS:** Fifty-one patients (29 males, 22 females; ages, 14–80 years) with 34 malignant and 17 benign soft-tissue tumors were evaluated for complications after resection alone (26 patients) or resection with radiotherapy (RadRx) (25 patients). Of the RadRx group, 17 had external beam therapy (ExtBeamRx), seven patients had additional brachytherapy (BrachyRx), and one patient had extracorporeal irradiation and reimplantation. Duration of follow-up averaged 3.75 years (malignant tumors) and 2.79 years (benign tumors). Follow-up included radiographs, standard MRI, and dynamic contrast-enhanced MRI (DCE-MRI) (TurboFLASH) for soft-tissue tumor site and CT and Tc-99m-MDP bone scans for metastases.

**RESULTS:** Recurrences were 2.2 times more frequent after resection at the outside hospital than at the university hospital. DCE-MRI differentiated 17 rapidly enhancing recurrent or residual tumors from slowly enhancing normal nerves and muscle inflammation and nonenhancing seromas and fibrosis around nerves and in soft tissue. Seromas were 10 times more frequent after RadRx than resection alone. Seromas persisted after BrachyRx but resolved after resection or ExtBeamRx. Soft-tissue inflammation was four times more common after RadRx than resection. Postoperative soft-tissue inflammation disappeared at 3 months, but post-RadRx changes resolved slowly from 6 months to 9 years after RadRx. Most bone complications (osteoporosis [12], fractures [7], and medullary infarct [1]) were related to RadRx. Acute and chronic sequelae of nerve entrapment and transection occurred after resection with or without RadRx.

**CONCLUSION:** This study suggests a possible relationship between the following types of therapy and specific complications of soft-tissue tumors: (1) between RadRx and osteoporosis, fractures, seromas, and soft-tissue inflammation; (2) between resection and heterotopic ossification and recurrences; and (3) between resection, with or without RadRx, and nerve entrapment and muscle atrophy. Diligent imaging follow-up, with the addition of DCE-MRI, can guide clinical care by differentiating benign complications from recurrences and thereby negate the need for surgery when benign disease is defined.

\* Faculty financial disclosures are located in the Faculty Index.

Thursday, March 25, 2010  
10:30 AM–12:00 PM

**SS03: Scientific Session 3  
Education I (Medical Students)**

**Location: Sapphire Ballroom E**  
Moderators: Donna Magid, MD, MEd  
TBD

ED

**(SS03-01) 10:30 AM  
Radiology-Anatomy Lab: Integrative Use of Foam and Plastic Models, Skeletons, Radiographs, and US to Explore Clinically Important Anatomy during a Radiology Clerkship**

Joseph A. Monteiro, *Boston Medical Center, Boston, MA*; Kitt Shaffer, MD, PhD; Nii-Kabu Kabutey, MD; Ann Zumwalt, PhD; Johanne E. Dillon, MD; Rebecca Lufler (joseph.monteiro@bmc.org)

**PURPOSE:** To describe the development of and assess student satisfaction with an interactive laboratory for reinforcing key gross anatomy concepts and emphasizing their relevance to diagnostic and interventional radiology during a radiology clerkship.

**METHOD AND MATERIALS:** An interactive anatomy-radiology laboratory session was added to the curriculum of the required radiology clerkship. With the guidance of instructors from the Departments of Anatomy and Radiology, small groups (3–5 students) rotated through four learning stations. Stations involved assembling models of the femoral triangle and subclavian region with readily available materials such as foam, tape, plastic tubing, and electrical wire, matching labeled structures of the shoulder and hip as seen on skeletons and various radiologic images, and using ultrasound to examine key vascular access sites. Students worked together to answer relevant work-sheet questions at each station. Students were surveyed for their responses to the content and design of the session.

**RESULTS:** Course surveys yielded a response rate of 69%. 100% of respondents “strongly agreed” or “agreed” that they had positive experiences at each of the stations. 100% of respondents rated the overall quality of the lab experience as “very good” or “good.” Most suggestions for improvement related to allowing more time for the lab and using more-durable materials for the model assembly stations.

**CONCLUSION:** An interactive and hands-on experience helps to reinforce important anatomic principles learned during preclinical medical education and to integrate them with clinical concepts relevant to radiology education.

**(SS03-02) 10:40 AM  
Developing a Radiology-based Teaching Approach for Gross Anatomy in the Digital Era**

David R. Marker, BS, *Johns Hopkins Hospital, Baltimore, MD*; Anshuman K. Bansal, BS; Krishna Juluru, MD; Donna Magid, MD, MEd (dmarker@jhmi.edu)

**PURPOSE:** To assess (a) the implementation of a digital anatomy lecture series that was largely based on annotated radiographic images and (b) the utility of the RSNA-developed Medical Imaging Resource Center (MIRC®) for providing an online educational resource for anatomy.

**METHOD AND MATERIALS:** A series of digital teaching images was collected and organized to correspond to lecture and dissection topics. Images were labeled to identify relevant anatomy, and case files were developed to demonstrate abnormal anatomy associated with various pathologies. MIRC was utilized to provide the images in a Web-based educational format for incorporation into anatomy lectures and as a review resource for the medical students. A 14-question Web-based survey was distributed to the anatomy students to assess their impressions of this educational format. MIRC Web server log files were assessed to determine student utilization patterns.

**RESULTS:** MIRC teaching files were successfully utilized in our teaching approach. The lectures were interactive, with questions to and from the medical student audience regarding the labeled images used in the presentation. Eighty-two of 120 students completed the survey. The majority of the students (87%) indicated that the MIRC teaching files were somewhat useful to very useful when incorporated into the lecture. The students who reported that they used the MIRC files for their anatomy exam preparation

were most likely to access the material from home (82%) on an occasional basis (76%). Recent Web server data showed between a four- and eightfold increase in the utilization of the MIRC site on the weekend compared to weekdays. With regard to areas for improvement, 63% of the students reported that they would have benefited from more teaching files, and only 9% of the students indicated that the online files were not user-friendly.

**CONCLUSION:** The combination of electronic radiology resources available in lecture format and on the Internet can provide multiple opportunities for medical students to learn and revisit 1st-year anatomy. MIRC provides a user-friendly format for presenting radiology education files for medical students.

**(SS03-03) 10:50 AM  
Using Radiology to Teach Physiology**

John Nay, BS, *Indiana University, Indianapolis, IN*; Vasantha D. Aaron; Richard B. Gunderman, MD, PhD (rbgunder@iupui.edu)

**PURPOSE:** To argue that radiology is well poised to play an important role in the teaching of physiology, one of the core disciplines of medicine. Physiology is an absolutely foundational medical discipline that informs every diagnostic test and therapy that physicians prescribe, and radiology teaches a deep understanding.

**METHOD AND MATERIALS:** Radiological case studies utilizing pairs of radiological cases, one illustrating normal physiology and the second illustrating pathophysiology, will be presented. The presentation will use the two radiological images (normal and pathophysiology) to focus on four broad physiological principles that apply across all organ systems. These principles are (1) homeostasis, (2) biological energy use, (3) structure-function relationships, and (4) communication. Two examples will be given for each of the principles.

**RESULTS:** Radiological case studies teach the integrating principles. A demonstration of the first integrated principle, homeostasis, is given. For example, cerebral perfusion scintigraphy measures blood flow to the brain and can determine if flow is disrupted. A normal study will demonstrate the tracer in the arteries and veins during the flow phase and accumulation of the tracer within the brain during the delayed imaging. A second clinical example of homeostasis is erythropoiesis. Two radiological examples (normal and pathological) of each principle support the use of radiology to teach physiology.

**CONCLUSION:** Radiological case studies can illustrate physiological principles in ways that can enhance students’ grasp of both the physiology and its role in helping physicians take better care of patients. Working with actual images brings physiology to life; the learning is relevant and practical.

**AUR Joseph E. and Nancy O. Whitley Award**

**(SS03-04) 11:00 AM  
Teaching Evidence-based Imaging in the Radiology Clerkship by Using the ACR Appropriateness Criteria®**

Johanne E. Dillon, MD, *Boston University School of Medicine/Boston Medical Center, Boston, MA*; Priscilla J. Slanetz, MD, MPH (johanne.dillon@bmc.org)

**PURPOSE:** With escalating health care costs and limited resources, effective utilization of imaging is essential to optimize patient care. Students have limited exposure to the evidence behind utilizing specific imaging modalities, and most students do not understand the indications for and clinical effectiveness of most imaging tests. Therefore, we introduced two focused sessions on evidence-based imaging during the radiology clerkship.

**METHOD AND MATERIALS:** From June 2008 to March 2009, 143 students in the radiology clerkship underwent a didactic session on principles of evidence-based imaging and then participated in a small-group case-based session and self-directed learning exercise using the ACR Appropriateness Criteria Web site as the primary resource. Twenty-five topics were covered, ranging from shortness of breath to acute abdominal pain and stroke. At the end of the clerkship, students evaluated this on a 5-point scale for its effectiveness in teaching imaging strategies and its impact on their future career.

**RESULTS:** Of 143 students (51 third-years, 92 fourth-years) in all, there were 134 out of 139 respondents (96%) who were not previously aware of the ACR Web site as a resource. With 143 responding, 132 (92%) found the ACR Appropriateness Criteria a useful resource, and 125 (87%) said they would likely use them in other rotations and future practice. After

\* Faculty financial disclosures are located in the Faculty Index.

these sessions, 118 (83%) felt challenged to think differently about radiology, and 126 (88%) said they had gained a solid understanding of the indications for certain imaging tests. Only 25 (17%) would have preferred a didactic session rather than the small-group and self-directed sessions. Ninety-three of 141 (66%) thought that navigating the ACR Web site on their own to investigate the appropriate imaging test for the 25 selected diagnoses was a useful learning exercise. Students praised the ACR Web site for its comprehensive coverage of the different modalities and relative radiation risks but noted the absence of relative cost information.

**CONCLUSION:** The ACR Appropriateness Criteria are a valuable resource for teaching evidence-based imaging to medical students. A majority of students indicated that they plan to use this resource in the future.

### **(SS03-05) 11:10 AM** **Using an Interactive Teaching Module to Educate Medical Students on How to Explain Radiology Studies and Procedures to Patients**

Laura L. Avery, MD, *Massachusetts General Hospital, Boston, MA*;  
Robert A. Novelline, MD, PhD (lavery@partners.org)

**PURPOSE:** Our medical students participate in a required 4-week clerkship integrated into their 3rd year of medical school. A goal of our clerkship is to increase our students' understanding of radiology studies and procedures. We apply a multifaceted approach to introducing these studies/procedures. Along with direct observation of procedures, our students participate in an interactive module to improve their ability to explain radiology studies/procedures to patients.

**METHOD AND MATERIALS:** Every month, our students participate in an interactive tutorial to improve their comfort and ability to explain radiology procedures to patients. Every student is assigned a radiologic study or procedure from a predetermined list. The student then researches the procedure by both direct observation in the department and also referencing *RadiologyInfo.org*. The student is responsible for understanding the patient "experience" while undergoing a procedure, from preprocedural preparation to degree of patient discomfort. During a dedicated teaching module, the students role-play the doctor-patient interaction with a fellow student, explaining the procedure and answering the other student's questions.

**RESULTS:** As a result of the teaching module, our students increase their understanding of patients' experiences while undergoing radiology studies/procedures. Students are given the opportunity to learn from one another and can learn about 5–10 different studies/procedures in a single session. Our students enjoy the interactive and fun role-play construct of the session and remain engaged throughout the session. Students are introduced to the existence of the patient-oriented radiology Web site *RadiologyInfo.org*.

**CONCLUSION:** Teaching medical students about how to explain radiology studies/procedures to patients can be done in a student-driven interactive format. We believe this format fully engages students to enhance their understanding of the patient experience. This module helps to expand our core clerkship's directive of teaching future clinicians about interpretation of radiology studies, proper utilization of radiology studies, and improved doctor-patient communications regarding radiology studies and procedures.

### **AMSER Henry Goldberg Medical Student Award**

### **(SS03-06) 11:20 AM** **Improving Medical Student Learning on Clinical Services through Resident-assisted Learning Modules**

Kevin C. McCammack, BS, *Indiana University School of Medicine, Indianapolis, IN*; Richard B. Gunderman, MD, PhD (rbgunder@iupui.edu)

**PURPOSE:** Medical students and residents are often unclear about the learning objectives for students on clinical rotations. In this project, we sought to improve the quality of medical student–resident interaction during a required 4th-year radiology clerkship by developing and implementing resident-assisted learning modules for each day that students are on clinical service.

**METHOD AND MATERIALS:** Learning modules were created which provide daily tasks for students to study and then demonstrate competency to reading room residents on each of the 5 days of their clinical assignment. The objectives for each subspecialty reading room involve demonstrating an understanding of normal anatomy, a reproducible search pattern, identification of key findings, and the ability to interpret "live" cases presenting to the

service. The modules were tailored to each of the eight subspecialties available to students. Student satisfaction values, as obtained through postclerkship questionnaires, were compared to previous assessments.

**RESULTS:** Students who completed their clinical rotations after the implementation of the learning modules reported improvement in their level of satisfaction with the clinical component of the radiology clerkship. Preliminarily, an average evaluation score of 3.22/5 suggests a statistically significant increase from prior values (95% confidence interval, 2.79 ± 0.20). In addition, students expressed a statistically significant improvement in their degree of overall learning, with a score of 3.78/5 (95% confidence interval, 3.59 ± 0.18). Students reported increased overall involvement, interaction with residents and staff, and an increased understanding of the process of image interpretation.

**CONCLUSION:** With the increasingly important role that radiology plays in the practice of medicine, it is vital that our emerging physicians have an understanding of the field of radiology, its scope and limitations, and the process of basic image interpretation. Our resident-assisted learning modules improved student evaluations of the reading room experience as well as overall evaluations of the clerkship.

### **(SS03-07) 11:30 AM** **Role of Residents in Enhancing Medical Students' Clinical Experience**

Matthew J. Scheidt, MD, *Indiana University School of Medicine, Indianapolis, IN*; Richard B. Gunderman, MD, PhD (rbgunder@iupui.edu)

**PURPOSE:** Too often, medical students on clinical radiology rotations play a purely passive role, merely observing as faculty members and residents do their clinical work. We attempted to address passive learning, limited resident-student interaction, and suboptimal radiology elective evaluations by developing a program to engage students during the clinical portion of their required radiology clerkship.

**METHOD AND MATERIALS:** Our institution's month-long radiology clerkship includes five half-day sessions of clinical experience in a radiology reading room. Traditionally, students played the role of spectators, but for this project, we required each student to collect one "interesting case" per day, which they presented the following day during a 30-minute case conference that included all clerkship students. Each student submitted a total of five cases to a dedicated secure e-mail account. Case information included patient name, medical record and accession numbers, clinical history, and presumed diagnosis. A volunteer resident presided over each case conference session to provide feedback on presentations, PACS instruction, and additional useful information as time allowed. In addition to the traditional evaluation, students completed a five-question supplemental questionnaire focused on the case review program.

**RESULTS:** A total of 3 months of evaluation data submitted by the medical students have been collected to date, one month from before the implementation of the program and two after. Overall, 66% and 73% find the case review sessions beneficial. On a scale of 1–5 (with 3 average and 5 outstanding), the average evaluation scores during the first 3 months are 3.91, 4.06, and 3.78, compared to 3.27, 3.0, and 3.55 for the 3 months prior, and 4.15, 3.86, and 3.72 compared to the same months of the year prior. Students most liked the "variety of cases," "informality," "students presenting," "seeing various modalities," and "taking ownership for an aspect of the course."

**CONCLUSION:** This program has enabled students to play a more active role in their own education. Overall, the majority of medical students felt they benefited from the increased interaction with the residents. Based on student feedback, we are continuing to refine this new learning opportunity.

### **(SS03-08) 11:40 AM** **Midterm Evaluation Increases Student Performance on the Radiology Final Examination**

Anthony S. Brooks, *Massachusetts General Hospital, Boston, MA*; Laura L. Avery, MD; Robert A. Novelline, MD; Raul N. Uppot, MD (abrooks5@partners.org)

**PURPOSE:** To determine whether administration of a radiology midterm examination is an effective tool for providing midrotation performance feedback to students and to see what, if any, impact this feedback has on the students' performance on their final examination, as well as their overall clerkship performance.

\* Faculty financial disclosures are located in the Faculty Index.

**METHOD AND MATERIALS:** The mean final exam scores of 100 students who were not given a midterm examination were analyzed in a side-by-side comparison against the mean final exam scores of 100 students who were administered a midterm examination. Additionally, a survey was sent to the entire group of 200 students requesting real-time feedback on whether they feel a midterm exam would have increased (or did increase) their score on the final examination, including specific comments to support their opinion.

**RESULTS:** The side-by-side comparison of final exam scores of students who were not administered a final examination, against those who were, revealed that there was a consistent sustainable performance increase on the final examination. Students who were administered a midterm examination performed an average of 3%–5% higher on the final examination than those who did not take a midterm examination. The general consensus of both the group of students who were given a midterm examination, as well as those who were not, was that having an opportunity to test their knowledge and retention rate of the core concepts, principles, and skills introduced during the first half of the course would be helpful in identifying areas in which additional study might be needed, as well as giving them a trial run at sitting a radiology examination.

**CONCLUSION:** Providing students with midrotation feedback, in the form of a midterm examination, enables students to assess their performance up to that point and devote concentrated study to the specific areas where their performance needs improvement. This in turn increases the potential for the students to retain vital concepts, principles, and skills necessary to enable them to perform at a higher level on the final examination.

#### AMSER Henry Goldberg Medical Student Award

#### (SS03-09) 11:50 AM Integrating the AMSER Curriculum into Clinical Clerkships by Using Case-based Online Radiology Education (CORE)

Elizabeth T. Chorney, MD, *Dartmouth Hitchcock Medical School, Lebanon, NH*; Petra J. Lewis, MD (petra.lewis@hitchcock.org)

**PURPOSE:** Radiology educators are challenged to integrate radiology into a saturated curriculum. In 2006, we presented our radiology case tool, CORE. Since then, we have introduced CORE into the 3rd- and 4th-year clinical clerkships.

**METHOD AND MATERIALS:** The AMSER curriculum was used as the foundation. Cases were published using CASUS™ authoring system. A CORE case includes a clinical scenario following a simulated patient through the clinical and imaging course of their disease. Cases include embedded images, discussions of radiation risk, cost, etc. Links are provided to the ACR Appropriateness Criteria®, articles, presentations, and educational Web sites. “Expert” tabs provide background information and resources. Students are prompted with questions to stimulate interactive learning. Parameters recorded include case completion, time taken, and evaluations.

**RESULTS:** Since 2005, 14 cases have been published by 13 faculty and students, covering topics in medicine, pediatrics, surgery, OB/GYN, neurology, and oncology. Over 75% of the AMSER curriculum has been incorporated. Students take cases during medicine, surgical, OB/GYN, pediatrics, and neurology clerkships. Completion of cases is required on OB/GYN and surgical clerkships and is optional on others. From 9/07 to 9/09, the mean number of students completing CORE was 148 students per case (median, 159; range, 38–256), taking a mean of 41 minutes per case to complete. Student evaluations have been extremely enthusiastic and enabled us to continually revise text and images.

**CONCLUSION:** CORE is a valuable method to integrate a standardized radiology curriculum into the 3rd- and 4th-year medical school clerkships. The imaging aspects of the specialty can be learned concurrent with the clinical information to improve both application and retention of knowledge. Clerkship directors should be encouraged to include completion of CORE cases as a clerkship requirement, to ensure that medical school graduates have an adequate knowledge of medical imaging.

## Thursday, March 25, 2010 10:30 AM–12:00 PM

### SS04: Scientific Session 4 Education II (Residents and Fellows) Location: Sapphire Ballroom I/M Moderators: Andrea Donovan, MD TBD

ED

#### (SS04-01) 10:30 AM Revisiting the Radiographic Features of Erosive Osteoarthritis: Review of 69 Patients

Durga Singh, MD, *University of Rochester, Rochester, NY*; Jeremy Sykes, MD; Kenneth Bricker, MD; Allen Anandarajah, MD; Gwy Suk Seo, MD, PhD; Johnny U. Monu, MD (durga\_singh@urmc.rochester.edu)

**PURPOSE:** One of the ways that erosive osteoarthritis (EOA), a destructive arthritis, differs from the other destructive arthritides is that it has no known targeted or effective treatment. It is therefore important to accurately characterize the type of arthritis to ensure appropriate management. The purpose of our study was to characterize the radiologic features of EOA using a large sample of patients with established EOA by clinical, radiographic, and laboratory criteria.

**METHOD AND MATERIALS:** Radiographs, scintigrams, and MRI of patients from our rheumatology clinic with an established diagnosis of EOA were reviewed independently by two MSK radiologists. Radiographs of the hands and feet were evaluated for characteristics previously described for EOA, including presence of erosions, osteophytes, joint space narrowing, and periosteitis. The distribution, prevalence, and severity of these findings were analyzed and correlated with the clinical findings.

**RESULTS:** Sixty-nine patients (57 females, 12 males) aged between 46 and 93 years (mean, 66 years) were studied. Forty-two hand and 27 feet radiographs were analyzed. Six patients had MRI and form the subject of another report. The characteristic feature of “central” articular erosion was seen in only 75% (52/69) of the patients. DIP joint involvement was most common (129 joints; range, 1–9 joints per patient), closely followed by PIP (71 joints; range, 1–7 joints/patient), with MCP and CMC joints much less commonly involved (three each). Less-specific findings of joint space narrowing, subchondral sclerosis, subcortical cyst formation, and marginal osteophytes followed a similar distribution and prevalence. Subluxations (nine patients, 46 total joints) and ankylosis (nine patients, 10 joints) were much less common. Marginal erosions were seen in only three patients. Periosteitis was not seen in any of the patients. No patient had abnormal ESR or CRP or features of rheumatoid arthritis or psoriasis.

**CONCLUSION:** Erosive osteoarthritis may be seen in older patients and in the absence of articular/central erosions. The distribution of central erosions was similar to previous descriptions. EOA more frequently affects the small joints of the hands, but the joints of the feet may be similarly affected.

#### AUR Memorial Award

#### (SS04-02) 10:40 AM Effect of Shift Type, Caseload, and Contiguous Workdays on Resident Call Performance

Matthew S. Davenport, MD, *University of Michigan Medical Center, Ann Arbor, MI*; Katherine A. Klein, MD; James H. Ellis, MD\* (mattdaven@med.umich.edu)

**PURPOSE:** To analyze the effects of shift type, hourly caseload, and contiguous workdays on resident call performance.

**METHOD AND MATERIALS:** Independent senior radiology resident “on-call” cross-sectional imaging interpretation quality assurance (QA) data obtained during a 72-day period at a single tertiary-care level 1 trauma teaching institution were reviewed. Cross-sectional imaging included CT, ultrasound, and MRI modalities covering multiple radiology subspecialties. Clinically significant discrepancies between resident and final attending interpretations were compared among three different call types: traditional single-day overnight call (OC, 15 hours/night after 9 daytime hours), 7-night night-float (NF, 9 hours/night), and weekend day call (WD,

\* Faculty financial disclosures are located in the Faculty Index.

10 hours/day). A single interpretation could include multiple body parts imaged with the same modality.

**RESULTS:** There were 48 (0.9%) resident-faculty discordances from 5645 cross-sectional interpretations: 19 (0.6%) from 2996 interpretations on 72 OC shifts, 18 (1.0%) from 1890 interpretations on 72 NF shifts, and 11 (1.4%) from 759 interpretations on 22 WD shifts. Mean caseloads (in interpretations per hour) of the assessed data were 2.8 (OC range, 0.9–4.0), 2.9 (NF range, 1.2–5.8), and 3.4 (WD range, 0.6–6.3). Across all call types, shifts with zero (minimum), one, and two (maximum) discordances had mean caseloads of 33 (range, 11–60), 35 (range, 20–55), and 41 (range, 29–52) interpretations, respectively. Individual residents had discrepancy rates of 0%–1.7% (mean, 1.4% over 19 residents). Thirteen percent of the total expected QA data were missing and could not be recaptured.

**CONCLUSION:** Higher caseloads and weekend day shifts are associated with an increased resident discordance rate. Traditional overnight call is associated with the lowest discordance rate. Converting traditional overnight call to a night-float system may not reduce discordant resident interpretations. Clinically significant resident-faculty discordance rates are low, regardless of the type of call employed.

### (SS04-03) 10:50 AM Using a Web-based Application to Enhance Resident Training and Improve On-Call Performance

Jason N. Itri, MD, PhD, *Hospital of the University of Pennsylvania, Philadelphia, PA*; Woojin Kim, MD; Regina O. Redfern; William W. Boonn, MD\*; Tessa Cook; Mary H. Scanlon, MD (jason.iritri@uphs.upenn.edu)

**PURPOSE:** To develop valid and reliable measures of resident performance, which are used to ensure effective training and good patient care.

**METHOD AND MATERIALS:** We have developed a Web-based application (Minerva) at our institution that allows both residents and the program director to compare preliminary interpretations with final reports and to grade each case as in agreement, minor discrepancy, or major discrepancy, depending on whether a discrepancy has the potential to affect patient management or outcome. Cases can be added to one of several databases for follow-up or teaching purposes, and a summary list of cases is reviewed periodically with the program director to assess on-call performance and is placed in the resident's learning portfolio. Minor and major discrepancy rates are used as a competency-based metric to assess readiness for call, evaluate call performance, establish benchmarks, and track trends in discrepant cases to identify programmatic deficiencies. All residents taking independent call present cases at monthly resident missed-case conferences and submit several cases to an ER conference folder on *MyPACS.net* as teaching files.

**RESULTS:** Trend analysis of missed cases was used to generate topic-specific resident missed-case conferences on acromioclavicular (AC) joint separation injuries, elbow joint effusions, and osteochondral fractures, which resulted in an overall 75% decrease in the number of missed cases related to these injuries over a 16-month period.

**CONCLUSION:** It is expected that Minerva and the evaluation process detailed above will result in better outcomes with respect to both patient care and resident education.

### (SS04-04) 11:00 AM A Return to the Basics: A Novel Way to Learn to Perform Musculoskeletal Procedures

Gregory Dieudonne, MD, *University of Rochester, Rochester, NY*; Scott Mooney, MD; Kenneth Bricker, MD; Veniamin Barshay; Malin Cesarz, MD; Johnny U. Monu, MD; et al (gregory\_dieudonne@urmc.rochester.edu)

**PURPOSE:** Few musculoskeletal (MSK) radiologists look forward to the start of the academic year, when fresh fellows with varying levels of experience have to be brought rapidly up to date on safe and efficient ways to perform MSK procedures. Occasionally the staff is trapped in the undesirable situation of teaching on an awake and reasonably alert patient. The purpose of this presentation is to share how we shortened this teething period and made it less of an ordeal.

**METHOD AND MATERIALS:** An introductory lecture to MSK interventions was held, with emphasis on the tools most used and procedures most performed at our institution. Two 4-hour training sessions were held at the beginning of the academic year. For each session, a lightly embalmed cadaver was loaned from the anatomy department and brought to our CT fluoroscopy suite. Also provided temporarily in the CT suite were

a C-arm fluoroscopy unit and an ultrasound unit. Various biopsy needles were made available, with which the fellows could familiarize themselves. The staff radiologists discussed the “when to” and demonstrated the “how to” use of the various pieces of equipment. The fellows were guided through target approach and needle placement in peripheral and deep structures. Following each session, the room and “machines” were thoroughly cleaned and disinfected by our environmental services.

**RESULTS:** Each of the MSK faculty attended at least one session. All of the MSK fellows attended all of the sessions. Each fellow practiced various simulated situations, such as arthrograms of various joints using fluoroscopy or ultrasound guidance; and biopsy of soft tissue and bone, including superficial and deep cortical, deep medullary, and intraarticular locations. The operative drill unit and the mallet were used, and lesion ablations were simulated. The sessions were very well received. Immediate observations are that our fellows approach and perform the procedures with more confidence; instructions during live interventions are down to a minimum; and procedure turnover time is improving.

**CONCLUSION:** This has been a revival for us. The benefits to our staff and fellows are immediately apparent. We plan to include this training as an annual feature in our curriculum.

### (SS04-05) 11:10 AM Call-Readiness Test for 1st-Year Residents: Construction and Administration of the Examination

Charles W. Bower, MD\*, *Mercy Hospital/University of Illinois, Chicago, IL*; Edward A. Michals, MD

**PURPOSE:** As radiology residents begin interpreting studies on call, it is imperative to assess that they have acquired adequate knowledge and skills to interpret studies without immediate supervision. We therefore administer a call-readiness test to assess the resident's ability to give appropriate reports for entire studies comparable to those that might be seen on call. We present here the format of the exam and its administration.

**METHOD AND MATERIALS:** Commercially available software (eFilm Workstation, Toronto, Ontario, Canada) is used to deliver the exam. The resident is given a paper answer sheet with the case number and a brief history comparable to what is usually received from our emergency department. The exam consists of 28 complete studies, along with two questions regarding handling of emergencies and administrative problems or questions. Trivia questions are included, primarily to verify absence of communication from the previous year's classes. The resident is given 3 hours to complete the exam and is allowed to use any resource other than another person. Internet access is permitted and is available on the exam workstation. The cases were selected based on actual call cases seen by the author and some contributed by other faculty members and were selected to cover the major subject areas. Negative studies are included. A second remedial exam consists of 15 questions, with two from each of the eight main areas (GI/GU being combined and one from nuclear medicine). The exam is scored by the same faculty member to avoid interobserver variability.

**RESULTS:** The software is easily installed on a Windows PC. Cases can be easily populated either by importing from CD-ROM or by DICOM transfer from PACS or an imaging modality.

**CONCLUSION:** A practical call-readiness test can be easily developed and administered using commercially available products. We intend to expand this approach to include similar periodic exams during training, to monitor educational outcomes.

### (SS04-06) 11:20 AM A Study of Learner Experiences with Mandated Learning Portfolios in Radiology

Margaret H. Mulligan, MS, PhD, *Medical College of Wisconsin, Milwaukee, WI*

**PURPOSE:** Study purpose was to examine residents' experiences with ACGME Residency Review Committee (RRC)-mandated resident learning portfolios. The Radiology RRC's mandate created a standard design and a common tool for interpretation and comparison. This study was needed to understand how an ACGME-mandated learning portfolio impacted learners' experiences and their perceptions of the portfolio's influence on practice. The study sought to answer the following questions:

(1) What do residents perceive the impact of ACGME-mandated learning portfolios is on their learning experience? (1a) How do residents perceive their ownership of the learning experiences in the portfolio? (1b) How do

\* Faculty financial disclosures are located in the Faculty Index.

residents perceive the tension, if any, between mandated learning and self-directed practice (Practice-Based Learning and Improvement)? (1c) How do residents perceive that portfolio experiences support or do not support their learning? (1d) What kinds of support (eg, technology, faculty, time) do residents perceive they receive during the portfolio process?

**METHOD AND MATERIALS:** A qualitative interpretive case study ( $n = 14$ ) at a U.S. academic medical center used interviews and document review to gather data. Data analysis protocols, member checks, and triangulation protocols were used to develop results.

**RESULTS:** The study found that (a) a majority of learners perceived the learning portfolio as both positive and negative and (b) the learning portfolio did not help them learn and failed to impact their approach to learning and to practice. Participants noted that learners had established successful learning styles, making the learning portfolio and elements of the portfolio redundant. Also, participants identified portfolio elements that they believed enhanced or hindered learning experiences and described the portfolio's impact on approach to learning and practice.

**CONCLUSION:** Study implications provide strategies to improve learning portfolio design and implementation, to improve learners' experiences, the portfolio's impact, and outcomes. There are implications for learners, the site program, and the ACGME-RRC in Radiology regarding commitment to portfolios, time, execution of elements, modeling processes, learner orientation, and issues related to intent and ownership/privacy.

### **(SS04-07) 11:30 AM** **Point/Counterpoint: A Discussion of 10 Strategies Related to Design and Implementation of Learning Portfolios from the GME Portfolio Literature**

Margaret H. Mulligan, MS, PhD, *Medical College of Wisconsin, Milwaukee, WI*; Guillermo F. Carrera, MD

**PURPOSE:** To review medical education literature for trends related to structure and implementation of learning portfolios within graduate medical education (GME), and follow with a discussion of their merits from the perspective of a radiology program director and GME educator in radiology.

**METHOD AND MATERIALS:** A literature analysis of papers and studies of portfolios and their use in medical education was gathered through a continuous search in Ovid, MEDLINE, PubMed, EBSCO, Academic Search, ERIC, JSTOR, and other databases. Search terms used and combined in different manners include, but are not limited to, portfolio, learning portfolio, residency, medical education, development, adult learner, collection, and assessment. Thirty-nine articles and studies that specifically addressed design and implementation as they related to learner experiences were identified, reviewed, and analyzed for common themes. After 10 themes were identified and studied, the program director and GME educator discussed and debated the themes for pragmatic implementation in radiology residency.

**RESULTS:** Identified themes include attitude and motivation, curriculum and instruction weaknesses, feedback, the need for mentoring, perceived importance, reflection, resistance to portfolios, time as a portfolio issue, tools and opportunities to learn how to reflect, and training. Each theme has implications for academic radiologists regarding strategies for successful learning portfolios in radiology, as demonstrated in the point/counterpoint discussion.

**CONCLUSION:** The ACGME learning portfolio mandate has shaken the already changing education context of radiology residency. This discussion of the themes and implications can assist academic radiologists in avoiding some of the challenges to portfolios and can help maximize a learning portfolio's educational outcome and the return on investment for residents and programs. The implications of these 10 themes serve as lessons for academic radiologists in portfolio structure and implementation.

### **(SS04-08) 11:40 AM** **Developing Radiology Residents as Leaders**

Richard B. Gunderman, MD, PhD, *University of Indiana, Riley Hospital for Children, Indianapolis, IN*; Darel E. Heitkamp, MD\*; Valerie P. Jackson, MD (rbgunder@iupui.edu)

**PURPOSE:** Radiology departments need to make greater investments in developing the leadership potential of the next generation of radiologists.

**METHOD AND MATERIALS:** We developed a year-long resident leadership program, which enrolled 15 volunteer residents from the 1st

through the 4th years of radiology training. The group meets twice per month for 2 hours. The curriculum includes study of a series of books, including Senge's *The Fifth Discipline*, Abrashoff's *It's Your Ship*, and Lewis's *Moneyball*, among others. In addition, each resident has developed a project. We have also invited outside speakers to present leadership topics at sessions with both the leadership group and all of our residents.

**RESULTS:** The leadership program has been very well received by residents. The discussions are lively, and participants are able to see many connections between the readings and their own professional experiences and aspirations. They have developed a variety of valuable projects. Examples include a program to deliver monthly lectures about radiology to community groups; a new medical student clerkship learning opportunity, where residents lead discussions of cases students have seen on their clinical rotations; a book chapter on selecting applicants to radiology residency programs; and a new program to educate radiology residents about the business of medicine. At the AUR meeting, we will have year-end participant evaluation data to present.

**CONCLUSION:** This program represents a practical and effective approach to educating radiology residents about leadership and developing their leadership potential. In addition, the program directly addresses a number of the ACGME competencies, providing ample material for each participant's learning portfolio. The approach described here could be adapted and implemented at other programs.

### **(SS04-09) 11:50 AM** **Current Status of Musculoskeletal Radiology Fellowships in the United States**

Stacy E. Smith, MD, *Brigham and Women's Hospital, Boston, MA*; Nisha Rao, MD; Warren Shephard, MD

**PURPOSE:** Currently, there is no nationwide curriculum for MSK fellowships. Data regarding educational experiences, similarities, and differences do not exist. The purpose of our study was to gather data on these and many other variables to serve as a baseline to guide further educational programs and/or a structured curriculum for MSK radiology fellowships.

**METHOD AND MATERIALS:** An anonymous 52-question computer-based survey was sent to all MSK radiology fellows in the United States via e-mail. Questions included general demographic data, training/work background, fellowship decision choices, ease of current fellowship interview system, current fellowship educational training status (variety of modalities available, diagnostic/interventional duties, call, research, teaching responsibilities, degree of mentoring, overall environment, and satisfaction), future/current job search, and academic/private practice career goals.

**RESULTS:** Sixty-eight surveys (74% M; 26% F) were filled: 80% east/central states; 88% U.S. residency training. Top reasons for choosing MSK included interest in field (79%), intellectual challenge (56%), job marketability (44%), and family proximity (30%). Word of mouth and Web site were top search methods. Fellowship applications ranged from one to 15 spots. 82% felt the number of positions available was adequate; 75% and 53% felt the search process was stressful or disorganized, respectively; 32% felt the process was great. Geographic/family restriction (67%) and "big name" (47%) were top reasons for selection. 82% received first choice. 100% felt fellowships met expectations, were accurately advertised, and would recommend. Breakdown of daily fellowship activity: 65% reported 21%–50% MRI/CT; 90% reported 11%–20% arthrograms/biopsies; 37% reported no spine interventions; 0% reported <10% ultrasound; and 58% reported 25%–50% plain film volume. Cases were evenly split among tumor, trauma, infection, and rheumatology, with heavier emphasis on sports medicine. 67% had attending supervision with radiographs; 97% felt adequate overall supervision. 53% would like to see a nationwide curriculum. Academic/private practice goals were split (41%/44%). 79% would stay at their current program.

**CONCLUSION:** Current status of MSK fellowships appears to be positive; however, work toward a more-structured curriculum would be beneficial.

\* Faculty financial disclosures are located in the Faculty Index.

Thursday, March 25, 2010  
10:30 AM–12:00 PM

**SS05: Scientific Session 5**  
**RAHSR (Health Services Research)**  
**Location: Aqua 306A**

**Moderators: Jeffrey G. Jarvik, MD, MPH\***  
**Marta E. Heilbrun, MD\***



**(SS05-01) 10:30 AM**  
**An Interactive Web-based Tool for Detecting Verification (Work-up) Bias in Studies of the Efficacy of Diagnostic Imaging**

Michael L. Richardson, MD, *University of Washington, Seattle, WA*;  
Jonelle Petscavage, MD (mrich@uw.edu)

**PURPOSE:** The efficacy of a diagnostic test is its ability to indicate the presence or absence of a disease. Sensitivity and specificity are two of the more commonly used indices of such efficacy. These indices are estimated by comparing the performance of a diagnostic test versus that of some “gold standard” test. However, when a diagnostic test is verified by an invasive, dangerous, or expensive gold standard, it is rare for all patients to undergo the gold standard. Naive estimates of sensitivity and specificity based only on patients with verified disease are often biased and tend to falsely inflate sensitivity and deflate specificity. Common synonyms for this type of bias include verification bias, sampling bias, work-up bias, referral bias, and selection bias. Although this type of bias has been recognized as a source of error for over 30 years, it is uncommon to find it mentioned in many published studies of diagnostic imaging efficacy. Furthermore, it is rare for such studies to include sufficient data to allow a reader to retrospectively detect the presence of verification bias.

**METHOD AND MATERIALS:** We have created an interactive Web-based program to assist in the detection of verification bias. Our tool combines HTML, the Ruby programming language, the R statistical software system, and a technique known as global sensitivity analysis (GSA). GSA calculates all possible values of sensitivity and specificity that are consistent with one’s observed data. Naive estimates lying outside these limits indicate the presence of verification bias.

**RESULTS:** Our tool demonstrates the presence of verification bias in several published studies of diagnostic imaging efficacy.

**CONCLUSION:** Verification bias is a common source of distortion of sensitivity and specificity. Prospective studies can be designed to prevent this bias. Retrospective studies with unverified subjects should report the number of such subjects. GSA can be used to determine whether estimates of sensitivity and specificity are consistent with one’s observed data. Publications should discuss potential verification bias. Readers should keep this bias in mind when using these indices to make clinical decisions.

**(SS05-02) 10:40 AM**  
**Interpretation Bias Introduced by Prior Reports**

Roli R. Agrawal, MBBS, MD, *Detroit Medical Center-Wayne State University, Detroit, MI*; Rohit Singla, MD; Wilbur L. Smith, Jr, MD (ragrawal@dmc.org)

**PURPOSE:** We evaluated error involved in resident interpretation of radiology exams with availability of prior reports. A controlled study was performed of the bias introduced by correct and incorrect prior reports.

**METHOD AND MATERIALS:** A test set of 14 plain radiographic exams was assembled. Both correct and incorrect reports were generated for these exams and provided to the participants with the images. Truth data were established by consensus of at least two board-certified radiologists and in correlation with electronic medical records and other imaging studies if available. The subjects interpreted the exams and were randomly provided correct and incorrect prior reports to assist in their interpretation. Participants interpreted these exams and filled out a standardized questionnaire for each exam (agree/disagree). After a hiatus of about 3 months, these radiology residents interpreted the same exams with a different report. Seven of 14 exams had an incorrect report deemed to be of significant clinical impact. The seven exams that had an incorrect report on the first occasion were exchanged for a correct report on the second occasion and vice versa. Twenty radiology residents of all training levels participated.

**RESULTS:** There was a tendency to agree with the prior report, and 54% overall agreed incorrectly with the incorrect report; however, there was a trend by resident training level to be less influenced by a prior incorrect report. 64% of the 1st-year residents’ interpretations agreed with the prior incorrect report, while it was only 47% for the 4th-year residents. 7% of interpretations falsely disagreed with a correct prior report.

**CONCLUSION:** There is significant bias in interpretation introduced by the availability of prior reports; however, this bias diminishes with advanced level of training.

**(SS05-03) 10:50 AM**  
**Evaluation of Interrater Agreement by Using the ACR RADPEER™ Scoring System on Discrepancy Cases**

Philip A. Dinauer, MD, *Hospital of St Raphael, New Haven, CT*; Felix Lin, MD; Lawrence Pan, BS; Gauri Tilak, MD; Diego Nunez, MD; William Zucconi, DO

**PURPOSE:** To evaluate local peer review committee interrater agreement when using the American College of Radiology (ACR) RADPEER scoring system on a group of cases with discrepant diagnostic interpretations.

**METHOD AND MATERIALS:** For quality improvement, our department recently began using the ACR RADPEER system. In this system, a score of 1 is defined as agreement between radiologists, a score of 2 is a difficult diagnosis not expected to be made, a score of 3 is a diagnosis that should be made most of the time, and a score of 4 is a diagnosis that should be made almost every time. The RADPEER system requires that all scores of 3 and 4 be reviewed by a local committee. In our peer review process, an internal committee reviews discrepant findings between radiology faculty, as well as between faculty and radiology residents taking independent overnight call. Radiology faculty deposit cases of disagreement with scores of 2, 3, and 4 in a secure password-protected electronic file. From this file, we retrieved 50 consecutive neuroradiology cases to test whether two subspecialty-trained radiologists could independently agree on the RADPEER scoring definitions. The raters were board-certified fellowship-trained neuroradiologists, each with 2 years of independent practice experience. Each rater studied the “RADPEER Scoring White Paper” by V. P. Jackson et al (*J Am Coll Radiol* 2009;6:21–25). The raters independently scored the 50 cases while aware of the missed diagnosis in each case. Radiology cases reviewed consisted of head CT ( $n = 24$ ), cervical spine CT ( $n = 15$ ), thoracic spine CT ( $n = 2$ ), lumbosacral spine CT ( $n = 1$ ), neck CT ( $n = 1$ ), paranasal sinus CT ( $n = 6$ ), and lumbosacral spine radiographs ( $n = 1$ ). Interrater agreement was evaluated using  $\kappa$  statistics.

**RESULTS:** Raters independently agreed in their RADPEER scoring of seven of 50 cases (14% of observations), resulting in a  $\kappa$  of 0.04. These results indicate that the strength of interrater agreement was poor.

**CONCLUSION:** There can be confusion regarding the meaning of RADPEER scores of 2, 3, and 4. Members of local radiology peer review committees may need further training and experience to standardize their scoring methods.

**(SS05-04) 11:00 AM**  
**Potential Impact of the American College of Radiology Appropriateness Criteria® on Cost, Utilization, and Radiation Exposure of CT for Trauma**



Delip V. Patel, MD, MBA, *Scott and White Memorial Hospital, Temple, TX*; Michael Nipper, MD (dpatel@swmail.sw.org)

**PURPOSE:** This study identified the utilization practices of computed tomography (CT) in the emergency department (ED) at Scott and White Memorial Hospital (SWMH) on trauma patients to determine what impact the implementation of the American College of Radiology Appropriateness Criteria (ACR-AC) would have on radiation dose reduction and financial costs.

**METHOD AND MATERIALS:** A retrospective analysis was conducted on 285 trauma patients who presented to the ED at SWMH between December 1, 2007 and March 1, 2008 and received a CT examination. Algorithms identifying indications for a CT examination were constructed using the ACR-AC literature and correlated with each patient’s medical record to determine the necessity of the CT imaging for immediate medical management. The costs and radiation exposure doses of the unrecommended CT examinations were subsequently calculated.

\* Faculty financial disclosures are located in the Faculty Index.

**RESULTS:** A total of 1410 CT examinations were completed on 179 male and 106 female patients with an average age of 40 years (range, 2 months to 88 years). The costs of CT imaging for the treated patients totaled \$1,935,247, or an average of \$6790 per patient, while SWMH incurred a cost of \$306,860 for completing the 1410 CT examinations. The trauma patients received an average estimated effective radiation dose of 32 mSv. The algorithm created from the ACR-AC literature did not recommend 619 CT examinations on the basis of patient presentations, which would have reduced the costs for the treated patients by \$881,986 (46%) to an average of \$3095 per patient and would have saved SWMH \$138,319 (45%). The estimated effective radiation dose would have been reduced by 51% to an average of 17 mSv per patient. Of the 619 unrecommended CT examinations, 68 (11%) revealed positive findings. Thirty-one of the 68 unrecommended CT examinations (46%) involved the thorax, with rib fractures ( $n = 14$ ) and pneumothorax ( $n = 11$ ) being predominant findings.

**CONCLUSION:** Regulatory interventions that optimize the allocation of medical resources are important. Our results suggest that implementation of the ACR-AC would help control rising CT imaging costs, drive efficiency, and improve patient safety without jeopardizing detection acuity.

#### (SS05-05) 11:10 AM Correlation among On-Call Resident Study Volume, Discrepancy Rate, and Turnaround Time

Naishadh A. Shah, DO, MBA, *Temple University Hospital, Philadelphia, PA*; Michael Hoch; Anthony Willis; Brent Betts; Harshad K. Patel, MD; Beverly L. Hershey, MD

**PURPOSE:** With continued increase in imaging utilization and remote-access image-viewing technology, many academic radiology departments are presented with the suggestion to supplement on-call resident preliminary reports with an outsourced attending interpretation. This idea is often brought to administrative attention because of the subjective impression that outsourced studies will benefit from significantly faster turnaround times and lower discrepancy rates, especially when study volume is high. We attempt to retrospectively analyze on-call resident studies at a busy trauma I university hospital and establish whether a statistical correlation exists among study volume, discrepancy rate, and turnaround time.

**METHOD AND MATERIALS:** 1050 on-call CT and US studies from 1/08 to 6/08 were retrospectively reviewed by blinded staff radiologists for discrepancies between preliminary and final reports. Discrepancies were rated based on a predetermined scale classifying type (example: false positive) and severity (example: major). A correlation analysis between discrepancy rate and study volume per shift was performed. In addition, correlation analysis between volume per shift and turnaround time (image acquired to preliminary report issued time) was also performed.

**RESULTS:** Initial results (approximately 800 studies) indicate an overall major discrepancy rate of less than 2.5% and average turnaround time of 30.4 minutes. The correlation coefficient between discrepancy rate and study volume is 0.17. The correlation coefficient between turnaround time and study volume is 0.16.

**CONCLUSION:** Our large retrospective review of on-call preliminary reports from different residents reveals no significant correlation among discrepancy rate, turnaround time, and study volume. The average turnaround time is within the range reported by major radiology outsourcing organizations. The overall discrepancy rate is similar to that reported by multiple other studies. We encourage other institutions to perform a similar study to analyze whether their after-hours volume and quality of preliminary reports warrant supplemental assistance before depriving residents of the educational benefits that the independent on-call experience affords.

#### RAHSR-ACR Award

#### (SS05-06) 11:20 AM Trend in Utilization of CT for Children Admitted to a Large Adult Level I Trauma Center

Bahman Roudsari, MD, PhD, *University of Texas School of Public Health, Dallas, TX*; Daniel S. Moore, MD; Jeffrey G. Jarvik, MD, MPH\* (bahman.roudsari@utsouthwestern.edu)

**PURPOSE:** Although CT has revolutionized radiology, the lifetime risk of cancer cannot be ignored, especially if patients undergo multiple irra-

diations during childhood. This study evaluates the trend in utilization of different types of CTs for patients younger than 19 years who are hospitalized in an adult level I trauma center.

**METHOD AND MATERIALS:** We linked the trauma registry (1996–2006) to the billing department data, using ICD-9 procedure codes to calculate the frequency and type of performed CTs during each hospitalization. We plotted the average number of CT scans per person per year to evaluate the crude change in utilization patterns during the past 11 years. In order to adjust the observed trends for patient and injury-related characteristics, we used negative binomial regression analysis and calculated the year-specific utilization rate ratio for each type of CT, considering 1996 as the baseline for comparison.

**RESULTS:** The utilization rate of head CT was almost unchanged between 1996 and 1999 (0.4 CT/person) and jumped to an average of 1.0 CT/person in 2000, where it remained steady through 2006. Neither abdominal nor thoracic CT demonstrated any substantial changes during the study period. The utilization rate of “other CTs” (including CT of extremities and spine) increased from an average of 0.1 CT/person in 1996 to more than 1.2 CTs/person in 2006. Using negative binomial analysis and after adjustment for age, sex, ethnicity, insurance status, mechanism and severity of injury, length of hospital and ICU stay, and final disposition at the time of discharge, we found that utilization of head CT in 2006 was approximately 60% higher than in 1996, while utilization of “other types of CTs” (excluding abdomen, thorax, and kidney) increased more than sixfold.

**CONCLUSION:** Our study demonstrated that while utilization of head CT during the past 11 years has slightly increased, the significant increase in use of other types of CTs among children requires prudent attention. Future studies will focus on identification of the factors that have influenced this higher utilization rate.

#### (SS05-07) 11:30 AM Analysis of Communication of Urgent and Unexpected Findings for Diagnostic Imaging Studies

Deepika Mittal, BS, *University of Maryland Medical Systems, Baltimore, MD*; Eliot L. Siegel, MD (dmitt001@umaryland.edu)

**PURPOSE:** Communication of urgent or unexpected findings is mandatory according to the ACR guidelines for communication. However, to our knowledge, there have been no previous studies that have evaluated the relative frequency and most-common reasons for communication of these findings. The purpose of our study was to analyze the frequency of those calls and to determine the types of studies that most often prompt those communications, as well as the most-common urgent and unsuspected findings that prompted communication with referring clinicians.

**METHOD AND MATERIALS:** The Baltimore VA Department of Radiology has a centralized system for calling and documenting urgent and unexpected findings utilized by all of the radiologists in the department. Calls were made for 4380 patients with urgent and unexpected findings on diagnostic imaging studies between October 2005 and September 2008, and these were documented in a database. A subset of the radiology reports from this database was individually reviewed to determine the most-common reasons for callbacks. A database of these patients was created with records of imaging modality, referring service, and reason for communication with referring clinicians.

**RESULTS:** The 4380 total reports called back from October 2005 to September 2008 represented 2% of the total number of studies performed in this time period. The most-common types of studies prompting communication with referring physicians were chest PA and lateral (40.0%), portable chest radiographs (11.6%), CT of the chest, abdomen, and pelvis (8.4%), myocardial perfusion studies (4.9%), and conventional radiographs of the foot (4.4%). The most-common reasons for callback included suspected neoplasm (39.6%), infections (21.0%), fractures (11.6%), and abnormal cardiac findings (9.3%).

**CONCLUSION:** The most-common causes for callback of urgent or unexpected findings were suspected neoplasm and infection. Overall callback rates at our institution were 2%; we are not aware of any prior studies that have established baselines for comparison. A centralized system can be used to facilitate documentation of findings, follow-up, and subsequent analysis of communication of urgent or unexpected findings.

\* Faculty financial disclosures are located in the Faculty Index.

**(SS05-08) 11:40 AM****Utilization of CT Angiogram and Postcontrast Head CT in Patients with Spontaneous Intraparenchymal Hemorrhage**

Ramesh S. Iyer, MD, *University of Washington, Seattle, WA*; Peter G. Stratil, MD, MBA; Wendy Cohen, MD; Michael L. Richardson, MD; Annemarie Relyea-Chew, JD, MS; Felix S. Chew, MD, MBA (riyer@u.washington.edu)

**PURPOSE:** To develop imaging guidelines for spontaneous intraparenchymal hemorrhage by identifying appropriate candidates for head CT angiogram (CTA) and postcontrast head CT.

**METHOD AND MATERIALS:** We retrospectively reviewed 600 consecutive emergency room head CTAs at one institution. Study inclusion required the scan to be the initial CTA and to demonstrate intraparenchymal hemorrhage. We excluded cases of trauma and prior surgical or endovascular intervention. The cases were reviewed separately by two radiology residents. Each resident reviewed the noncontrast CT and CTA components of the exam and then reviewed the noncontrast and postcontrast CT portions 2 weeks later. The scans were assessed for hemorrhage characteristics on the noncontrast study and etiology, if present, on the contrast-enhanced components. Logistical regression analysis was performed to elicit variables most predictive of identifying hemorrhagic etiology.

**RESULTS:** A total of 130 cases were included. Forty-one cases had an anatomic etiology (aneurysm, arteriovenous malformation, tumor, or vasculitis) demonstrated on either the CTA or postcontrast study. The postcontrast study failed to identify three ruptured aneurysms (average size, 5.3 mm). No patient over the age of 80 years ( $n = 16$ ) had an identifiable etiology. No patient under 30 years ( $n = 11$ ) had aneurysmal hemorrhage. No patients with hemorrhage confined to basal ganglia, thalamus, or brainstem had an identifiable etiology. Patients with hemorrhage involving the brainstem, basal ganglia, or thalamus are significantly less likely (odds ratio = 0.125) to have an anatomic etiology. Patients with basal cisternal hemorrhage are significantly more likely (odds ratio = 12) to have an anatomic etiology.

**CONCLUSION:** We have proposed imaging guidelines for patients with spontaneous intraparenchymal hemorrhage. Patients over 80 years or those with hemorrhage confined to the brainstem, basal ganglia, or thalamus should not receive contrast for initial evaluation. CTA is needed if an aneurysm is suspected; patients between the ages of 30 and 80 years or those with hemorrhage involving cerebral lobes or basal cisterns should receive a head CTA. Patients under 30 years or those with multiple hemorrhagic foci should receive a postcontrast head CT only.

**(SS05-09) 11:50 AM****Self-reported Reliance of Primary Care Residents on Radiology Reports as Residents Progress through Training**

Sherwin Danaie, MD, *George Washington University Medical Center, Washington, DC*; Katie C. Nicholas; Mark Domanski; Raymond Tu (sherwin@gwu.edu)

**PURPOSE:** Primary care residents are exposed to radiographs and sonograms routinely during training. As attending physicians, many may invest in their own imaging equipment. Data are sparse regarding where these physicians gain the training and confidence in interpreting radiologic studies.

**METHOD AND MATERIALS:** A nationwide Web-based survey of internal medicine, pediatrics, and family medicine residents was performed. Residents were queried about their field of specialization, postgraduate year of training, and hospital setting. Residents were asked about their reliance on radiology reports versus their independent interpretations of ultrasound studies, as well as chest and MSK radiographs.

**RESULTS:** A total of 527 primary care residents responded to the survey. Residents self-identified as 30.7% family medicine, 33.2% internal medicine, and 36.1% pediatrics. 66.2% of residents were at university hospitals, while 33.8% were based at community hospitals. PGY-1, PGY-2, and PGY-3 represented 34.1%, 31.8%, and 29.5%, respectively, of the respondents. The remaining respondents were PGY-4 and beyond. When self-reported dependence on radiology reports was compared between 1st- and 3rd-year residents, there were no statistically significant differences for bone and chest radiographs ( $P > .05$ ). For ultrasound, 3rd-year residents reported themselves to be more reliant on the radiology report than the 1st-year residents ( $P = .007$ ). Comparing university- and community-based

training programs, there were no significant differences for dependence on chest and bone radiograph reports. However, for ultrasound, again there was a statistical difference between the two groups ( $P = .03$ ), with university-based residents being slightly more dependent on radiology reports than their community-based counterparts.

**CONCLUSION:** As primary care residents progress through their training, there is no trend toward independently interpreting radiographs. In fact, the residents report an increasing reliance on radiologists for ultrasound reports. Therefore, the primary care attending physicians who interpret their own radiographs must develop their skills and confidence outside of the classic postgraduate educational training.

**Thursday, March 25, 2010  
10:30 AM–12:00 PM****SS06: Scientific Session 6****Informatics****Location: Sapphire Ballroom H**

Moderators: Michael L. Richardson, MD  
Nabile M. Safdar, MD\*

IN

**(SS06-01) 10:30 AM****Automated Systematic Evaluation of Resident Reporting (ASERR)**

Kamran Shah, MD, *University of Maryland, Baltimore, MD*; Paul Nagy, PhD; Fauzia Q. Vandermeer, MD; Wayne C. LaBelle III (kshah@umm.edu)

**PURPOSE:** We developed a tool, ASERR, to analyze the quality of resident reports by automatically comparing resident preliminary and attending final reports.

**METHOD AND MATERIALS:** ASERR captures resident preliminary reports and attending finalized reports from the electronic medical record and automatically compares them. ASERR includes a Web-based system that displays each finalized report with standardized markup. The data are received from an "honest broker," such that no individual identifiers or links are accessible to the authors. Hence, this research is not considered human subject research and is IRB exempt. Analysis is performed for number and type of edit, number of words deleted and added, and total report size, among other variables, broken down by resident, attending, section, and modality.

**RESULTS:** We processed 7928 reports generated by 34 residents and 54 attendings over 87 days; 5834 reports were signed unchanged (74% of resident-dictated reports). Of edited reports, 18% of content was changed. Mammography attendings altered nearly 54% of report content, with 85% of all resident-dictated mammography reports undergoing revision. Although other sections fell within one standard deviation, outliers included nuclear medicine, pediatric, and chest radiology attendings, who edited 19%, 0.40%, and 0.7% of the content of their resident-dictated reports. We did not see a significant trend in percentage of reports edited by resident year; but when analyzed for number of words changed per edited report, there was a significant difference, with an average of 57 words changed in edited reports dictated by 1st-year residents, and 41, 50, and 34 words changed on average for 2nd, 3rd, and 4th years (mean,  $46 \pm 9$ ). Radiography reports were significantly less likely to be edited than other modalities. The most commonly edited reports were from mammograms (85%) and MRI (59%).

**CONCLUSION:** Initial analysis shows that the majority of resident-dictated reports are signed unedited. Of edited reports, 18% of content was changed, with data suggesting substantive edits. While there was no correlation between number of reports edited and year of training, the number of words changed per edited report was correlated with resident year.

**(SS06-02) 10:40 AM****Characterizing the Frequency and Context of Uncertainty in Mammography Reporting**

Bruce Reiner; Naomi J. Saenz, MD; Micah S. Adams, BA; Eliot L. Siegel, MD; Narendra S. Shet, MD, *University of Maryland Medical Center, Baltimore, MD*

**PURPOSE:** To quantify and characterize diagnostic uncertainty in radiology reporting.

\* Faculty financial disclosures are located in the Faculty Index.

**METHOD AND MATERIALS:** An ontology was created to identify and characterize essential clinical components contained within mammography reports and mapped to the BI-RADS lexicon. Data mining of a multi-institutional mammography database was subsequently performed using natural language processing (NLP) software, which was externally validated through a manual report audit. Terms of uncertainty were extracted from the report database and analyzed for frequency and context of use.

**RESULTS:** A total of 125,330 reports were analyzed, with 4.4% of reports containing uncertainty terms (eg, could be). The frequency distribution of these uncertainty terms was found to be statistically significant ( $P < .01$ ) when correlating with the specific finding and context in which it was used. The most common findings with associated uncertainty included mass (46.0%), calcifications (37.1%), and focal/asymmetric density (13.4%), in the context of the differential diagnosis, follow-up recommendations, and interval change.

**CONCLUSION:** Uncertainty is a common occurrence in traditional reporting, reflecting some degree of equivocation and lack of diagnostic confidence on the part of the interpreting radiologist.

#### **(SS06-03) 10:50 AM**

##### **Automated Report Extraction and Analysis in the Classification of Malignant Probability for Mammographic Calcifications**

Naomi J. Saenz, MD; Bruce Reiner; Micah S. Adams, BA; Eliot L. Siegel, MD; Auzhand Y. Zonozy, MD, *University of Maryland Medical System, Baltimore, MD*

**PURPOSE:** To identify and categorize the specific report features predicting malignant potential for the finding of “calcification” on mammography.

**METHOD AND MATERIALS:** Data mining of a multi-institutional mammography database was performed using natural language processing (NLP) software, after external validation through a manual report audit. The extracted report data were referenced to a mammography ontology containing critical report content features mapped to a standardized report lexicon. All mammography reports describing the presence of “calcification” were subsequently analyzed to determine the specific report features that predict malignant potential and BI-RADS classification.

**RESULTS:** Of the 103,674 mammography reports analyzed, 7709 (7.4%) reported the presence of “calcification,” findings which were collectively reported to have benign characteristics in 75.8% of cases (BI-RADS 2 and 3), malignant characteristics in 9.2% of cases (BI-RADS 4 and 5), and uncertain characteristics in 15.0% of cases (BI-RADS 0). The specific descriptive features with the highest predictive value in malignant categorization related to focality and morphology ( $P < .01$ ). For focality characterization, the descriptor with the highest association of malignancy was “clustered” (22.9%); the descriptor with the highest association of uncertainty was “grouped” (79.8%), while the descriptors with the highest association of benignity were “scattered” (81.3%) and “diffuse” (60.0%). For morphology characterization, the descriptors with the highest association of malignancy were “pleomorphic” (79.1%) and “irregularly shaped” (46.7%), while the descriptors with the highest association of benignity were “round” (85.1%) and “coarse” (83.0%).

**CONCLUSION:** The specific descriptive reporting features used in association with mammographic findings (eg, calcification) can serve as a predictor of malignant potential and facilitate accurate computer-generated BI-RADS categorization.

#### **(SS06-04) 11:00 AM**

##### **Integration of a Free-Text Radiology Information System Search Application with a PACS and Digital Teaching File System to Facilitate Education and Research**

Mark S. Frank, MD, *Indiana University, Indianapolis, IN*; Darel E. Heitkamp, MD\*; Marc D. Kohli, MD; Shawn D. Teague, MD\*

**PURPOSE:** To facilitate the discovery, review, and collection of radiologic cases for use in education and research.

**METHOD AND MATERIALS:** We have developed and deployed a high-speed free-text search engine for mining our radiology information

system (RIS) data. The system enables interactive Web-centric searching for cases based on text within the radiologist’s report, including use of Boolean combinations, proximity searches, and algorithms tailored to improve specificity of results. Simultaneously available with free-text searching is the capability to also search for data elements such as modality, body part, date range, patient’s age and gender, reporting radiologist, etc. Search hits are displayed as a scrollable list within an embedded browser frame. Each search hit includes specific data elements in a two-line header plus full text of report (four display formats are actually available). Included in the displayed header of each hit are two small interactive icons with special functionality. One icon, when clicked, activates our PACS software and causes immediate display of that exam. We use a Web-centric PACS with identical viewing software on our PACS workstations and most departmental computers. Another icon, when dragged and dropped onto our digital teaching file (DTF) case-entry software, will immediately invoke a new-case operation, invisibly perform a “behind-the-scenes” retrieval of data from the search-engine server, and automatically fill out the new record with exam-centric information, including demographics plus text of the report automatically parsed by the software into history, findings, and impression data elements. The radiologist can immediately begin adding images to the case via automated screen scraping or via copy/paste, depending on personal preference.

**RESULTS:** Previously cumbersome time-consuming activities required for discovering and collecting useful case material for education and research have been reduced to a matter of a few mouse clicks with immediate results, thus saving radiologists a great deal of time and also enhancing discovery.

**CONCLUSION:** Innovative integration of information systems in a radiology department can serve to facilitate education and research.

#### **(SS06-05) 11:10 AM**

##### **Turnaround Time: New Approaches for Visualization of Comparative Data within a Radiology Department**

Mark S. Frank, MD, *Indiana University, Indianapolis, IN*; Kenneth A. Buckwalter, MD\*

**PURPOSE:** To provide interesting and actionable graphical representations of turnaround time (TAT) for our radiologists, including self-versus-self (over time) and self-versus-section data, in order to enhance self-perspective and provide visual incentives to improve quality of service.

**METHOD AND MATERIALS:** Data elements are harvested for each examination from our radiology information system (RIS) and stored in a RIS data warehouse developed in our department. Included are time stamps: exam completed, exam dictated, and exam final-signed. Other elements include dictating radiologist, signing radiologist, and exam code and description. Software calculates for each exam the time  $\Delta$  from exam completed to exam dictated (C-D) and from exam dictated to final-signed (D-F), the sum of these representing overall TAT. These calculations are rolled up and averaged monthly and quarterly by radiologist and by departmental section. All such roll-ups are stored in a separate table serving as a container of monthly and quarterly TAT results for all radiologists and sections. Contents of this table are fed to custom software modules that flexibly report on any combination of months/quarters and generate Web-centric graphical comparisons thereof. Each report also includes total count of exams by radiologist and percentage dictated by resident for each period depicted. All output is Web-compatible, with reports periodically published on a protected Web page for all radiologists to review.

**RESULTS:** We will demonstrate three different graphical analyses that we generate to provide diverse perspectives of TAT, including visualizations of C-D and D-F intervals. Results have been both positive and somewhat provocative, both being intended outcomes. TAT has decreased. Readily visible objective metrics have served as a wake-up call for some radiologists, confirmed exceptional performance by others, and, importantly, helped reveal system problems pertaining to TAT and fueled conversations focused on rectifying them.

**CONCLUSION:** Innovative visualization of performance metrics can help improve quality of service within a radiology department. Specific examples and associated graphical representations will be discussed.

\* Faculty financial disclosures are located in the Faculty Index.

**(SS06-06) 11:20 AM**  
**Automatically Tracking Delays in Report Availability Caused by Incorrect Examination Status with Web-based Issue Tracking: A Quality Initiative**

Omer A. Awan, MD, *University of Maryland, Baltimore, MD*; Frans van Wagenberg, MS; Mark Daly; Nabile M. Safdar, MD\*; Paul Nagy, PhD (omer.awan786@gmail.com)

**PURPOSE:** Many radiology information systems (RISs) cannot accept a final report from a transcription system before the exam has been completed by a tech in the RIS, the images having been transferred to PACS independently. As market pressures have accelerated the reporting time of a radiologist to near real time, any delays in completing the study by the tech can delay reporting. Radiologists can still render a report in a reporting system once images are available, but the RIS does not get the results, delaying patient care. We developed a Web-based reporting tool to track uncompleted exams and automatically page the appropriate section supervisor when a report is being delayed.

**METHOD AND MATERIALS:** A Python script periodically polls the speech-recognition dictation system for exams which are signed by the radiologist but are unable to be sent to the RIS. This script logs the exams into an existing Web-based, QC issue-tracking tool using PHP and a MySQL database. Additionally, the script e-mails or text-pages the modality supervisor. The script logs when the report is finally able to be sent, and statistics are aggregated onto a separate Web-based reporting tool. Every instance of an uncompleted exam has facilities for logging actions by techs and supervisors for postincident review.

**RESULTS:** Integration with the existing QC Web tool and in-house paging system resulted in a clean work flow for the techs. In January 2009, the system went live, with 304 studies identified as uncompleted, with a median time to resolution of 270 minutes. Several sections were unaware they were having trouble completing studies, and this opened a conversation in sections about their work flow. These data were discussed at a bimonthly operations meeting with the supervisors. In June 2009, the tool identified 199 studies in this uncompleted status, with a median time to resolution of 170 minutes.

**CONCLUSION:** Automatically tracking a previously anecdotal problem has yielded excellent results in improving turnaround time from a clinician's perspective. The automated feedback provides a vital link in improving technologist performance and patient care without assigning a human resource to manage the report queues.

**(SS06-07) 11:30 AM**  
**DORIS (Dig Our RIS): A Combined Free-Text and Data-centric Web-based "Search" Application for Mining Radiology Information System Data**

Mark S. Frank, MD, *Indiana University, Indianapolis, IN*; Kenneth A. Buckwalter, MD\*; David Hennon; Marc D. Kohli, MD

**PURPOSE:** To provide fast, interactive RIS data-mining capabilities to facilitate activities in quality improvement, education, research, and business intelligence.

**METHOD AND MATERIALS:** An HL7 interface connects our radiology information system (RIS) to a data warehouse (DW) constructed by our development team. The DW receives approximately 35 data elements from the RIS for each examination, including patient name/ID, several time stamps, exam code and description, radiologist(s), and full text of the interpretation. The DW stores these in a database and also feeds specific elements, including the interpretation, into a text-indexing engine, creating a high-performance free-text index holding fast backlinks to each exam in the database. A Web-centric interface enables flexible queries. The system uses a two-tier authentication mechanism to ensure that only authorized personnel have access. Data are transmitted via SSL encryption.

**RESULTS:** DORIS has served over 2600 searches in its first 3 months of operation. The DW currently holds 3.7 million exams spanning 8 years. Response time is typically within fractions of a second and virtually always within 10 seconds. Wildcard searches, proximity searches, and Boolean operations are supported. An optional specificity builder is available to enhance "true-positivity" of a search by eliminating reports containing so-called pertinent-negative terminology (eliminating reports with phrases

like "No evidence of [desired finding]," "Negative for [desired finding]," etc). Datacentric searching is simultaneously supported. Thus, free-text criteria can be combined with criteria such as date range, age range, gender, x-ray modality, body part, dictating radiologist, signing radiologist, etc. Results can be displayed in formats ranging from full report text to only a hit count. Results can be sorted by relevance, patient name, or exam date. Results can be exported in Excel, XML, or text format.

**CONCLUSION:** An interactive RIS search engine can be very useful and serve multiple purposes within a radiology department. We will discuss architectural strategies, HIPAA issues, and ways we have found to maximize utility of the system.

**(SS06-08) 11:40 AM**  
**RADIANCE: Creating an Analytics Platform for Resident Lectures**

Micah S. Adams, BA, *University of Maryland, Baltimore, MD*; Wayne C. LaBelle III; Charles S. Resnik, MD; Fauzia Q. Vandermeer, MD; Jean Jeudy, MD; Eliot L. Siegel, MD (madams2@umm.edu)

**PURPOSE:** According to a national survey conducted last year by our department, 76% of residents surveyed were completing a residency program at an academic hospital. Sixty percent of residents answered that lectures were offered at least twice a day, and 55% of residents responded that they attended both lectures offered daily. Since last year's survey, our department has put significant effort into creating an information system that offers a clear analysis of lecture attendance and CME credit tracking for faculty and staff.

**METHOD AND MATERIALS:** The Radiology Attendance System (RADIANCE) hardware interface is a card reader that obtains data, processes this information via predefined business logic, and then stores the information. Data read from card swipes are compared to data available in our lecture calendar application. Our system saves all courses taught; these data are compared to the information gathered from card reads. Registered cards are flagged with data about the individual's role in the department. The system allows any magnetic stripe card to be associated with a user, regardless of make or manufacture.

**RESULTS:** Our data sets for lecture attendance have become much more reliable with our card-reader system. This new solution complements the preexisting work flow of a sign-in sheet for tracking resident attendance, and it does not force an individual to bring an electronic Web-enabled device to lectures. With more reliable information, we have been able to run attendance metrics against these data sets and requested metrics based on the sets of data we capture.

**CONCLUSION:** Our first attempt at creating an educational platform was a single system that tracked lecture attendance, shared materials with participants, and gave lecturers the opportunity to poll audiences in real time about the content they were presenting. However, this solution did not offer us reliable data about lecture attendance and was designed in such a way that it forced participants to log into a Web system to verify their presence at a lecture. This subsequent development effort has created a reliable system to track lecture attendance with a finer grain of data and a complementary interface for lecture participants.

**(SS06-09) 11:50 AM**  
**Technique for Rapid and Automated Analysis of the Adrenal Gland on CT Images by Using a Combination of a Segmentation Algorithm and a Statistical Classifier of Histogram Values That Uses Thin-Section CT**

Naomi J. Saenz, MD, *University of Maryland Medical System, Baltimore, MD*; Ganesh Saiprasad, BS; Bharath Ramakrishna; Eliot L. Siegel, MD

**PURPOSE:** The selection of a region of interest within the adrenal gland can be arbitrary and operator dependent. We hypothesize that segmenting the entire adrenal gland (manually or semiautomatically) and then creating a histogram analysis using data from thin-section CT and then performing advanced statistical analysis not only can improve accuracy but also can be achieved without any additional interpretation time by the radiologist.

**METHOD AND MATERIALS:** Ten cases with adrenal adenomas and another 10 cases with normal adrenal glands were collected. The adrenal was manually segmented, and a histogram was computed for all of the adrenal pixels collected from a given adrenal. Sample mean and sample covariance matrix were calculated. Using the multivariate Gaussian models

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for normal and adenomatous glands, statistical classifiers were built to optimally distinguish between normal adrenals and adrenal adenomas. The user traces the boundary of the adrenal gland on multiple slices, and the pixels from these slices are pooled, and their histogram is calculated. The calculated histogram was fed to the statistical classifier, which gives a likelihood score for the given adrenal gland to be normal or adenoma.

**RESULTS:** Twenty cases, 10 abnormal and 10 normal, were obtained. The classifier was able to classify eight normal and the 10 adenoma cases accurately. More tests are under way with a larger test set to calculate the sensitivity and specificity of our technique. The segmentation algorithm was able, in a supervised semiautomated mode, to rapidly delineate the boundaries of the adrenal gland.

**CONCLUSION:** It is likely that a combination of the use of the entire adrenal gland, rather than a region of interest, and thin-section CT can substantially improve characterization of adrenal pathology. We believe that this combination will substantially improve diagnostic efficacy and speed in comparison to approaches previously described and can be implemented on a typical PACS workstation. Presentation modes could include quantitative analysis and prediction of likelihood and characterization of adrenal pathology and/or a graphical depiction of the analysis of the adrenal.

## GERRAF Sessions Thursday, 7:00–8:15 AM

### (G-01) Quantitative Molecular Characterization of Musculoskeletal Lesions with Proton MR Spectroscopy

Laura M. Fayad, MD\*, *Johns Hopkins University, Baltimore, MD*

**PURPOSE:** To demonstrate the potential utility of proton MR spectroscopy (MRS) for measuring the absolute concentration of choline ([Cho]) in musculoskeletal (MSK) abnormalities.

**METHOD AND MATERIALS:** At 3 T, [Cho] levels were measured in 20 subjects with MSK abnormalities by MRS (water-referencing method previously validated by our group). MSK abnormalities included malignant (three sarcomas), borderline-malignant (one neurofibroma with atypia), and benign (one fracture, one abscess, one hematoma, one cyst, one giant cell tumor, one neurofibroma, one lipoma, one ependymoma, one pigmented villonodular synovitis, seven postoperative fibrosis proven by stability) entities. MRS (PRESS: TR, 2000 ms; TE, 144 ms) was performed with a  $2 \times 2 \times 2$ -cc single voxel in the most suspicious portion of each MSK abnormality, as identified by conventional MRI. Descriptive statistics were reported for the presence of a Cho signal peak and the [Cho].

**RESULTS:** A Cho peak was identified in all malignant ([Cho], 3.4, 2.9, and 2.2 mmol/kg), one borderline-malignant ([Cho], 0.3 mmol/kg), and two benign MSK abnormalities ([Cho], 0.1 and 0.2 mmol/kg). All other benign abnormalities showed no Cho peak ([Cho], 0). The average [Cho] in benign abnormalities was  $0.02 \pm 0.05$  mmol/kg.

**CONCLUSION:** The results demonstrate a quantitative measure of metabolic alterations in MSK abnormalities and show that benign and malignant lesions may potentially be differentiated by MRS.

### (G-02) Evaluation of MR Imaging and MR Spectroscopy of the Breast at 3 T

Eva C. Gombos, MD\*, *Brigham and Women's Hospital, Boston, MA*

**PURPOSE:** To evaluate the integration of magnetic resonance spectroscopy (MRS) into clinical imaging practice during 3-T magnetic resonance imaging (MRI)-guided breast biopsy procedures.

**METHOD AND MATERIALS:** This IRB-approved study is in progress on 46 consecutive patients referred to our service for MRI-guided intervention (wire localization for surgical excision or core-needle biopsy) of an MRI-detected breast lesion. In order to validate integration of MRS into clinical imaging practice for noninvasive evaluation of patients with breast lesions, we perform magnetic resonance imaging (MRI) with single-voxel Point-RESolved Spectroscopy (PRESS) (TE/TR, 135 ms/2000 ms; vector size, 1024 points; bandwidth, 2000 Hz; number of averages, 128) in the enrolled patients. Spectra are acquired after patient positioning for biopsy and immediately prior to the biopsy procedure.

Spectroscopy and imaging data are recorded, and histopathologic results (including breast cancer subtypes) of the lesions are correlated with the MRS results.

**RESULTS:** The specificity and sensitivity between 3-T MRS with 3-T MRI and histology correlation (benign vs malignant) MRS were regarded as successful and concordant in 82.6% of the cases. The sensitivity was 60%, the specificity was 100%, the positive predictive value was 100%, and the negative predictive value was 76.5%. There was no significant difference between breast cancer subtypes, most likely due to the small sample size.

**CONCLUSION:** MRS may be a helpful adjunct of breast diagnostics on clinical 3-T MR exams and may increase the specificity of breast MRI.

### (G-03) Perfusion CT Imaging of Brain Tumors: In Vivo Evaluation of Heterogeneity of Tumor Angiogenesis Using Correlation of Perfusion CT Parameters with Histological Angiogenesis Markers—Progress Report

Rajan Jain, MD\*, *Henry Ford Hospital, Detroit, MI*

**PURPOSE:** The purpose of this research is to assess glioma vasculature and neoangiogenesis using perfusion CT with the following objectives: (1) to assess usefulness of perfusion CT for in vivo evaluation of brain tumor angiogenesis; (2) to evaluate the heterogeneity of tumor angiogenesis and its correlation with histological and angiogenesis markers by comparing various perfusion CT parameters, such as tumor blood volume (tBV) and permeability–surface area product (PS) with microvascular density (MVD) and microvascular cellular proliferation (MVCP) obtained by image-guided biopsy specimens.

**METHOD AND MATERIALS:** Thirty patients with gliomas who have not undergone any treatment and who will be undergoing surgical intervention will be included in the study. Perfusion studies will be performed using 64-slice (VCT; GE Medical Systems, Milwaukee, WI) multi-detector row CT scanners in all the patients. At the time of surgery, multiple biopsy specimens will be taken for each patient from within the tumor volume to be resected using image guidance using co-registration of the perfusion CT maps and MRI obtained with contrast obtained preoperatively with fiducial markers. Perfusion maps of CBV, CBF, MTT, and PS will be generated at an Advantage Windows workstation using CT perfusion 3.0 software (GE Medical Systems) and two-compartment model in all patients. Multiplanar MR image used for stereotactic biopsy sample will be matched with the corresponding perfusion CT map, and an ROI will be drawn manually on the perfusion CT map to match the site of the biopsy specimen. CBV, PS, CBF, and MTT values obtained from the perfusion CT maps will be used for final analysis and correlated with histopathological assessment.

**RESULTS:** Preliminary results showed that MVD correlated with CBV, whereas PS correlated with MVCP.

**CONCLUSION:** CT perfusion may be used as a noninvasive in vivo alternative/adjunct to histopathological evaluation, which may be used to assess regional heterogeneity of angiogenic vasculature in tumors. In addition, the whole tumor can be evaluated using an in vivo perfusion imaging technique, which may not be possible with histopathological evaluation of the surgical specimen.

## Friday, 8:00–9:30 AM

### (G-04) Premature Coronary Artery Disease (CAD) in Severe Psoriasis

Prachi P. Agarwal, MD\*, *University of Michigan Health System, Ann Arbor, MI*

**SPECIFIC AIM 1:** Compare the prevalence of CAD in patients with and without severe psoriasis, otherwise matched for cardiovascular risk factors, as determined by (a) CT coronary calcium scoring and (b) coronary CTA (CCTA). **Study Design:** This cross-sectional study design will enroll patients with severe psoriasis from the clinics of the University of Michigan Health System. The control group will be matched by age, gender, and Framingham risk score to the psoriasis population; and recruitment will be targeted in the dermatology clinic by screening for matching variables before enrollment. Assessment after eligibility screening will consist of psoriasis severity grading, cardiovascular risk assessment,

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laboratory tests, and CCTA. *Outcomes Measured:* Overall prevalence of CAD will include patients with calcium score  $>0$  and/or noncalcified plaque. *Data Analysis:* A conditional logistic regression model will be used to examine the effect of psoriasis on the probability of having CAD, conditioning on age, gender, and Framingham risk score.

**SPECIFIC AIM 2:** Compare the atherosclerotic plaque burden of CAD in patients with and without severe psoriasis, otherwise matched for cardiovascular risk factors, as determined by (a) CT coronary calcium scoring and (b) CCTA. *Study Design:* The study design is identical to that described for specific aim 1. *Outcomes Measured:* The calcium score (AJ 130) will be compared between patients with and without severe psoriasis otherwise matched for major coronary risk factors. On CCTA, number of arterial segments demonstrating more than minimal coronary arterial narrowing ( $>30\%$  stenosis) will be compared to determine atherosclerotic plaque burden. The overall severity of CAD will be determined using the Duke CAD index model applied to CCTA, as proposed by Min et al. *Data Analysis:* The effect of psoriasis on the probability of having more than minimal coronary arterial narrowing (defined as stenosis  $>30\%$ ) and using the modified Duke index, will also be examined using a conditional logistic regression model. Odds ratios with 95% CIs and significance test results will be reported for psoriasis and other factors in the model. An exploratory model of the severity of CAD, measured by overall severity score, degree of stenosis, and calcium score, will be conducted between patients with and without psoriasis using unpaired  $t$  tests or nonparametric Wilcoxon rank sum tests. Significance levels for all tests will be set at 0.05.

### **(G-05) Distinguishing Recurrent High-Grade Glioma from Postradiation Change: Can Advanced MR Imaging Techniques Predict Outcome?**

James R. Fink, MD\*, *University of Washington School of Medicine, Seattle, WA*

**PURPOSE:** Imaging findings for recurrent glioma and postradiation effects substantially overlap on contrast-enhanced MRI (CE-MRI). Advanced MRI techniques have been suggested to distinguish between glioma recurrence and postradiation change better than CE-MRI alone. The current gold standard for distinguishing recurrent glioma from postradiation change is tissue biopsy. Biopsy may also predict survival in this clinical setting. However, biopsy is susceptible to sampling error, and gliomas may display variable histologies, as well as overlap between radiation effects and tumor recurrence. Tissue sampling is also an invasive and costly procedure with concomitant risks for morbidity and mortality. The application of advanced MRI techniques to this important clinical problem could potentially alleviate the need for tissue biopsy. We therefore propose to investigate whether making this clinically important distinction between glioma recurrence and postradiation change through advanced MR techniques can provide useful prognostic information regarding progression-free survival, overall survival, functional status, and quality of life in patients with clinically suspected glioma recurrence. We hypothesize that the diagnosis of recurrent glioma by advanced MR imaging will be associated with decreased progression-free survival, decreased overall survival, and diminished functional status and quality of life as compared to patients with postradiation change suggested by advanced MRI. We also hypothesize that patients with postradiation change on advanced MRI will have similar survival and functional performance as patients who do not have CE-MRI findings suspicious for recurrent tumor. Specific aims include the following: (1) Determine that the quantitative information acquired through advanced MRI techniques, including metabolic peak height ratios Cho/NAA and Cho/Cr, rCBV ratio, and ADC ratio, distinguishes recurrent glioma from postradiation change using a combined gold standard of surgical histopathology and clinicoradiologic follow-up. (2) Assess the diagnostic accuracy of each of these advanced MRI techniques individually in distinguishing recurrent glioma from postradiation change through ROC analysis, and assess the influence of quantitative information from each technique on diagnostic accuracy through logistic regression analysis. (3) Determine the impact of advanced MRI techniques on clinical outcomes, including progression-free survival, overall survival, functional status, and quality of life.

### **(G-06) The Use of Stress Cardiac MR Imaging as the Initial Imaging Modality for Intermediate-Risk Patients with Stable Symptoms Suspicious for Coronary Artery Disease: Is It More Cost-Effective than Myocardial Perfusion Imaging and Stress Echocardiography?**

Saurabh Jha, MBBS\*, *University of Pennsylvania School of Medicine, Philadelphia, PA*

Ischemic heart disease continues to be a major player in morbidity and mortality in the developed world. Additionally, the costs associated with the diagnosis of ischemic heart disease are coming under increasing public scrutiny. The current study uses decision modeling and Markov analysis for an economic evaluation of various imaging modalities for the initial assessment of the patient with stable symptoms of chronic ischemic heart disease. The modalities evaluated include stress MRI, stress echocardiography, and nuclear scintigraphy.

## **Friday, 10:30 AM–12:00 PM**

### **(G-07) Randomized Prospective Study of FDG PET/CT Surveillance versus Planned Neck Dissection in Management of Patients after Successful Chemoradiotherapy for Advanced Head and Neck Squamous Cell Cancer**

Rathan M. Subramaniam, MD, PhD\*, *Boston Medical Center, Boston, MA*  
**PROGRESS:** Boston University Medical Campus IRB finally approved in December 2009 after amendments. Case report forms have been created. We have started screening patients for the study and are yet to enroll our first patient.

**EDUCATIONAL COMPONENT:** Application for the Clinical Effectiveness program (summer 2010) at Harvard School of Public Health is in progress. This will satisfy one-third of the credit required to do the MPH.

### **(G-08) Computer-aided Quantitative Evaluation of Trauma Head CT**

Esther L. Yuh, MD, PhD\*, *University of California, San Francisco, San Francisco, CA*

**PURPOSE:** To improve traumatic brain injury (TBI) classification through computer-aided quantitative evaluation of acute trauma head CT studies. Establishing effective computer-aided methods for head CT evaluation would enable more-objective standardized classification of acute TBI for improved risk stratification and for better selection of research subjects for clinical trials of experimental interventions.

**METHOD AND MATERIALS:** Using a suite of computer algorithms that evaluates for the presence of acute intracranial hemorrhage and/or mass effect based on (1) presence or absence of a subdural or epidural hematoma, (2) presence or absence of subarachnoid hemorrhage, (3) presence or absence of intraparenchymal hemorrhage, (4) presence or absence of clinically significant midline shift ( $\geq 5$  mm), and (5) normal, partly effaced, or completely effaced basal cisterns, we performed computer-aided quantitative evaluations of 257 acute CT studies performed on patients admitted to the ICU with acute head trauma at San Francisco General Hospital from November 2005 to September 2009. We compared the computer-aided quantitative head CT evaluations to Extended Glasgow Outcome Scale (GOS-E) scores at 6 months after injury.

**RESULTS:** Generalized linear modeling was used to perform analysis of variance (ANOVA) using qualitative predictors (age; Glasgow Coma Scale [GCS] score; presence or absence of subarachnoid, subdural, and epidural hemorrhage; and presence or absence of midline shift and basal cistern effacement) versus quantitative predictors (age; GCS score; quantities of subarachnoid, subdural, and epidural hemorrhage; and quantitative assessments of intracranial mass effect).

**CONCLUSION:** Quantitative CT features in trauma head CT can be used to achieve a small but statistically significant improvement in outcomes prediction in acute head trauma. When compared to previously developed models employing age, GCS, and traditional qualitative CT predictors, use of quantitative CT predictors significantly increases corrected  $R^2$  values from approximately 47% to approximately 52% in the population of patients admitted to the ICU for acute head trauma.

\* Faculty financial disclosures are located in the Faculty Index.

## AUR 2010 Research Poster Abstracts

Research posters are located in Sapphire Ballroom B/C/F/G. Each poster will be presented by its author during *AMA PRA Category 1 Credit™* poster sessions scheduled for 7:00–8:15 AM, Wednesday and Thursday. The day and time follow the presentation number.

Presenting author is identified by institution name, city, and state (or country if not United States or Canada). Presentations by trainees (residents, medical students, or first-year fellows) are noted in blue.

### (P-01) Wednesday • 7:00–8:15 AM Institutional Survey of House Staff Alumni

Linda A. Deloney, EdD, *University of Arkansas for Medical Sciences, College of Medicine, Little Rock, AR*; Robert F. Buchmann, DO; Elizabeth Hicks, MD; James A. Clardy, MD (DeloneyLindaA@uams.edu)

**PURPOSE:** To accrue information from house staff alumni about the quality of their training via an institutional-level survey on an annual basis. Postgraduation reflection on training, especially in comparison to graduates from other programs and the realities of medical practice, provides information about program effectiveness that cannot be gained from any other source. The project supports program directors who have limited time and resources to develop new assessment tools.

**METHOD AND MATERIALS:** After an extensive review of the literature and sample surveys, data were selected in three domains: (a) demographics; (b) satisfaction with preparation for practice, adequacy of training, and general competencies; and (c) career satisfaction. Free-text items were included to encourage candid comments about program strengths and weaknesses and suggestions for improvement. The survey instrument was accessed at <http://www.surveymonkey.com/>. Responses were recorded without personal identifiable data in a secure dedicated study database. After a final reminder e-mail, the survey was officially closed for the year, and data were downloaded from the survey sponsor site.

**RESULTS:** For the initial administration, 57 programs provided contact information for 2004 and 2008 graduates. Invitations to participate explained the survey and provided assurance that responses would be recorded anonymously, securely, and without personal identifiable data. Participation was voluntary, and completion of the survey constituted consent. To date, 43 responses have been received.

**CONCLUSION:** Because ACGME-accredited programs must collect feedback on house staff performance from an external source and because alumni surveys on the quality of training are a potential measure of educational outcomes, we conclude that data generated by an annual institutional survey will identify training program strengths and areas for improvement, as perceived by recent graduates, to inform the educational process at the program and institutional levels. In addition, our work contributes to the literature on program evaluation in medical education, an area of literature which is lacking.

### (P-02) Thursday • 7:00–8:15 AM Accurate Fluoroscopic Measurement of Adjustable Laparoscopic Gastric Band Stoma Diameter

Robert G. Hayter, BS, MD, *Hospital of Saint Raphael, New Haven, CT*; David Colley, MD (hayter.md@gmail.com)

**PURPOSE:** To correlate accurate fluoroscopic measurement of the laparoscopic gastric band stoma diameter with patient symptoms for optimal band stoma adjustment.

**METHOD AND MATERIALS:** Ten patients with laparoscopic gastric bands were enrolled after informed consent. A 13-mm barium sulfate tablet was administered and swallowed with dilute liquid barium during fluoroscopic monitoring. A spot radiograph was obtained once the barium tablet was in the gastric pouch and the dilute liquid barium was in the gastric band stoma. The longest radiographic dimension of the barium tablet was used as the size reference to calibrate measurement of the laparoscopic gastric band stoma diameter.

**RESULTS:** All 10 patients tolerated the procedure. After calibrating the measured laparoscopic gastric band stoma diameter to compensate for magnification effects, the gastric band stoma diameter range was 2.5–8.2 mm. Three patients with calibrated laparoscopic gastric band stoma diameters of 2.5 mm had a history of vomiting or reflux. Seven patients with calibrated laparoscopic gastric band stoma diameters of 3.4 mm or greater had a history of no weight loss.

**CONCLUSION:** Administration of a barium tablet with dilute liquid barium to laparoscopic gastric band patients allows the accurate measurement of the band stoma diameter. The technique is quick and easy to perform and eliminates fluoroscopic magnification error. Given these results, the optimal calibrated laparoscopic gastric band stoma diameter is 3.0 mm. Accurate fluoroscopic measurement of the laparoscopic gastric band stoma diameter can optimize initial band stoma adjustment to a calibrated 3.0 mm, improve weight loss, minimize side effects, and reduce the need for follow-up band stoma adjustments.

### (P-03) Wednesday • 7:00–8:15 AM Comparative Analysis of Two Methods for Ranking of Applicants for Radiology Residency

Michelle S. Collins, BS, *Yale School of Medicine, New Haven, CT*; Anne M. Curtis, MD; Keyonna C. Artis, BS; Lawrence H. Staib, PhD; Jamal Bokhari, MD (michelle.collins@yale.edu)

**PURPOSE:** The introduction of bias is commonplace and difficult to eliminate when comparing radiology residency applicants for ranking. This research aims to evaluate the integration of a mathematical model by Yale's selection committee, adopted in an attempt to reduce biases.

**METHOD AND MATERIALS:** For 3 consecutive years, beginning with the 2006–2007 interview season, three rank order lists were compiled: The "subjective" list was developed by committee consensus on appropriate rank for each applicant. For the "mathematical" list, interviewers individually maintained a rank list for only the applicants they interviewed. Once interviewers ranked all of their interviewed applicants, a reciprocal mathematical equation was applied, yielding a fractional score. As in most institutions, each applicant is interviewed by several people (three in the case of our institution). The three fractional scores were added, and all applicants were ranked in descending order according to this final score. The "NRMP" list was created by comparing the subjective and mathematical lists to identify applicants with a difference of greater than 10 rank order positions. These applicants were reassessed and reassigned, if deemed necessary by the selection committee, to form the finalized "NRMP" list.

**RESULTS:** Over 3 years, 224 applicants were ranked in total, with 109 of those reevaluated (49%) and 24 ultimately reassigned (11%). In addition to catching applicants affected by bias, another category of "drifters" was also discovered. Drifters are applicants whose rank order drifts solely because of focus on other applicants who were inserted above or below them.

**CONCLUSION:** The mathematical method used in parallel with the subjective method has proven useful in reducing bias and error and in identifying "drifters," to create a rank order list.

### (P-04) Thursday • 7:00–8:15 AM A Unique Method for Introducing Radiology to Medical Students as Paid Radiology Triage Assistants during Off-hours at a Major Academic Medical Center

Douglas J. Davis, MD, PhD, *Yale School of Medicine, New Haven, CT*; Scott Kennedy, MD, MBA; Howard P. Forman, MD; Syed A. Bokhari, MD (douglas.davis@yale.edu)

**PURPOSE:** To describe a program employing medical students to assist with triaging off-hour diagnostic imaging studies at a major academic medical center.

**METHOD AND MATERIALS:** Current and former Yale radiology staff and Yale medical students who participated in the off-hour Radiology Triage Program were interviewed and surveyed regarding the inception, development, and impact of this program. Student participation and triage activities were compiled and tabulated from scheduling records and triage assistant call logs.

**RESULTS:** Opportunities for medical students to obtain an intensive well-organized experience in radiology are often absent or occur relatively late

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during medical school, which can be problematic for making timely well-informed decisions regarding radiology as a career path. This paper describes a unique program that provides students with a rigorous hands-on experience in radiology relatively early in their training. The Yale Department of Radiology employs students from the School of Medicine to assist the staff with triaging off-hour studies on weekday evenings, weekends, and holidays. Students work directly with an ED radiology attending and residents, and they are responsible for fielding all off-hour requests for ED radiology and teleradiology, for triaging and coordinating imaging studies, for providing follow-up to clinicians, and for answering or redirecting miscellaneous inquiries. Although the program was conceived with the intent of streamlining off-hour radiology work flow, it has proven to be a useful training experience for the students as well. Since its full implementation in fall 2005, over 60 Yale medical students have participated, and many of them credit this program as a major influence in their residency considerations. While this program continues to evolve, it has met with widespread approval by the students and radiology staff from the outset.

**CONCLUSION:** The employment of medical students as radiology triage assistants provides a unique in-depth exposure to clinical radiology relatively early in medical school while also providing an effective and well-accepted system to streamline the off-hour work flow for radiology attendings, residents, technicians, and support staff.

**(P-05) Wednesday • 7:00–8:15 AM**  
**Diagnostic Performance of Elastography for the Evaluation of Breast Lesions Less than 15 mm in Diameter**



Todd R. Kumm, MD; Kerry L. Thomas, MD, *H. Lee Moffitt Cancer Center/University of South Florida, Tampa, FL*; Margaret Szabunio, MD; Alec Chau (kthomas1@health.usf.edu)

**PURPOSE:** To assess the diagnostic performance of freehand ultrasound elastography in the evaluation of small breast lesions (<15 mm in size).

**METHOD AND MATERIALS:** Patients referred for ultrasound-guided biopsy of a suspicious breast lesion were included in this study after informed consent was given. Patients with lesions measuring 15 mm or less in greatest diameter were included in the analysis. Elastography score (ES) images and strain ratio (SR) measurements were obtained for each lesion targeted for biopsy. A lesion was considered ES test negative if scored 0, 1, or 2; while a score of 3, 4, or 5 was considered ES test positive. A lesion was considered SR test negative if the ratio was <4.5, while a ratio of  $\geq 4.5$  was considered SR test positive. Sensitivity, specificity, negative and positive predictive values, and test accuracy were calculated using core-needle or excisional biopsy results as the standard.

**RESULTS:** A total of 349 lesions from 283 patients were evaluated. Lesions measuring less than 15 mm in total diameter were included in this analysis. For ES: sensitivity, 0.80; specificity, 0.83; PPV, 0.55; NPV, 0.94; and accuracy, 0.8. For SR: sensitivity, 0.82; specificity, 0.83; PPV, 0.52; NPV, 0.95; and accuracy, 0.77. For combined ES/SR: sensitivity, 0.82; specificity, 0.82; PPV, 0.54; NPV, 0.94; and accuracy, 0.8.

**CONCLUSION:** The use of elastography in the assessment of suspicious breast lesions detected with conventional ultrasound has the potential to identify lesions with decreased risk of malignant biopsy results. The use of secondary selection criteria such as size, as selected in our study, may help to further identify lesions for which elastography assessment may provide additional reliable prognostic data. Study limitations include a small sample size and potential selection bias, as our site serves as a cancer referral center. Continued study of this method may help to identify patients who may be selected for interval follow-up in lieu of immediate biopsy.

**(P-06) Thursday • 7:00–8:15 AM**  
**Diagnostic Performance of Color Elastography Scoring and Strain Ratio Assessment in the Evaluation of Breast Lesions: Experience at a Single Cancer Referral Center**

Tiffany M. Tucker, MD, *H. Lee Moffitt Cancer Center/University of South Florida, Tampa, FL*; Todd R. Kumm, MD; Alec Chau; Margaret Szabunio, MD

**PURPOSE:** H. Lee Moffitt Cancer Center is a referral center with a large number of patients presenting for US-guided biopsy of suspicious breast lesions. Biopsied breast lesions yielding a benign result represent a costly component of a breast cancer screening program. Elastography is proposed to be a noninvasive alternative to characterize suspicious lesions and to differentiate benign from malignant lesions of the breast. Our study evaluated the diagnostic performance of ultrasound elastography using elastogram scoring (ES) and strain ratio (SR) measurements of breast lesions referred for biopsy.

**METHOD AND MATERIALS:** Patients referred for US-guided biopsy of suspicious breast lesions were included in this study after informed consent was obtained. ES images and SR measurements were obtained for each targeted lesion. Lesion was considered ES test negative with a score of 1 or 2; while a score of 3, 4, or 5 was considered ES test positive. Lesion was considered SR test negative if ratio was <4.5 and was considered SR test positive if ratio was  $\geq 4.5$ . Sensitivity, specificity, negative and positive predictive values, and test accuracy were calculated using core-needle or excisional biopsy results as the standard.

**RESULTS:** A total of 136 target lesions from 118 patients were included in the analysis. For ES: sensitivity, 0.67; specificity, 0.79; PPV, 0.54; NPV, 0.87; and accuracy, 0.76. For SR: sensitivity, 0.74; specificity, 0.78; PPV, 0.47; NPV, 0.92; and accuracy, 0.77. For combined ES/SR: sensitivity, 0.75; specificity, 0.78; PPV, 0.41; NPV, 0.94; and accuracy, 0.77.

**CONCLUSION:** Elastography assessment provides additional information about the malignant potential of a target lesion. Combining ES and SR measurements resulted in a higher negative predictive value. Elastography has the capability to become a successful diagnostic tool and can be valuable in helping to identify patients who could avoid biopsy and become candidates for follow-up imaging. This has the potential to decrease biopsies of benign breast lesions. Further evaluation is, however, needed to establish the target population and the future clinical applications of ultrasound elastography.

**(P-07) Wednesday • 7:00–8:15 AM**  
**Radiologist-Technologist Communication with Respect to Digital Radiography Image Quality at a University Center: A Preliminary Quality Improvement Project**

Keith D. Herr, MD, *Emory University, Atlanta, GA*; Kimberly E. Applegate, MD, MS

**PURPOSE:** To assess the current climate of communication between radiologists and technologists regarding image quality at a large university-based medical center with residents and fellows and to identify potential barriers to communication that may affect patient care.

**METHOD AND MATERIALS:** A link to a Web-based survey was e-mailed to attending radiologists and radiology trainees. An additional survey was given to radiology technologists who perform digital radiography. The goal was to assess perceptions of communication between radiologists/trainees and technologists with respect to image quality of digital radiographs. Respondents were asked to focus on their experience in the preceding 3 months. A five-item Likert scale was used to categorize the quality of radiography and radiologist-technologist communication.

**RESULTS:** Thirty-three of 125 radiologists/trainees (24% attendings, 76% trainees) and 16 of 26 technologists responded to the surveys. About 50% of physician respondents were satisfied or very satisfied (Likert 4 or 5) with the quality of digital radiographs in the preceding 3 months. Another 50% were either neutral or dissatisfied (Likert 3 or 2). Over 50% of radiologists estimated that 6%–25% of images were suboptimal but still interpretable; 50% believed that up to 10% of images were nondiagnostic. However,  $\geq 80\%$  of radiologists indicated that they seldom or never provided feedback. 50% of technologists reported that they had not received feedback from radiologists/trainees, supervisors, or colleagues regarding

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image quality. The vast majority (94%) were nonetheless satisfied (Likert 3, 4, or 5) regarding their personal interactions with radiologists.

**CONCLUSION:** Radiologists and trainees rarely communicate image quality information to technologists, despite the perception of a high rate of substandard images. Lack of a standardized method of communication, physical distance between reading room and technologist work area, and lack of QC monitors were identified as likely root causes. Based on these findings, several improvement interventions were implemented (repeat-reject analysis software and logbook of physician feedback).

**(P-08) Thursday • 7:00–8:15 AM**  
**Pediatric Radiology Teaching File for Evaluation of Radiology Resident Knowledge Base**

Joseph T. Jordahl, MD, *University of Iowa Hospitals and Clinics, Iowa City, IA*; Yutaka Sato, MD; Rick Axelson; Susan Lenocho; Joan Maley, MD

**PURPOSE:** Our aim was to evaluate baseline diagnostic radiology resident knowledge in fundamental cases of pediatric radiology. After distributing an educational tool, we monitored progression to a satisfactory knowledge base. Our ultimate goal is to instill a satisfactory knowledge base in pediatric radiology earlier in residency training.

**METHOD AND MATERIALS:** Thirty-two individuals were enrolled in the study based on level of radiology training (R1, R2, R3, R4, and fellow). Six diagnostic radiology fellows were initially administered a pretest consisting of 100 pediatric radiology cases. The fellows were considered the gold standard of satisfactory knowledge base in pediatric radiology, considering they had all recently passed the pediatric radiology section of the ABR oral boards in May 2009. Twenty-six radiology residents were administered the same pretest. After the pretest, an educational tool was provided to all radiology residents, consisting of more than 150 “must-know” pediatric radiology cases with associated keywords.

**RESULTS:** Baseline scores on the 100-case pretest by class were 26.63 (R1), 43.00 (R2), 59.33 (R3), 70.50 (R4), and 78.00 (F), with a total mean ( $n = 32$ ) of 53.69 and 95% confidence interval of 46.18–61.19. The increase in mean scores with examinee experience level indicates that these items are closely related to the knowledge gained over time in residency. Further, the ANOVA indicates that these differences are statistically significant. These results are evidence of the pretest’s validity. Individual knowledge level is tested at the end of 4-week pediatric radiology rotations using the same case material, while group knowledge level is again tested at the end of the academic year using different case examples of the same entities.

**CONCLUSION:** The present teaching curriculum should be readjusted to accompany the recently proposed new ABR testing schedule. In each subspecialty rotation of radiology, residents should obtain substantial amounts of key concepts, and progress must be evaluated and documented. Providing a locally developed case-based educational tool, which can be used to monitor knowledge progression, may facilitate the earlier acquisition of fundamental radiology concepts.

**(P-09) Wednesday • 7:00–8:15 AM**  
**Improved Understanding of Human Anatomy through Radiology Instruction**

Andrew W. Phillips, BA, *University of Chicago, Chicago, IL*; Callum Ross, PhD; Sandy G. Smith, PhD; Christopher M. Straus, MD\* (cstraus@uchicago.edu)

**PURPOSE:** Radiology continues to be an ever increasing part of gross anatomy instruction, yet data demonstrating its effectiveness are lacking. Studies to date demonstrate student support and improved interpretation of radiographic images. Here we examine the impact that radiology instruction has on learning anatomical relationships, quantified by radiology, gross, and written exams.

**METHOD AND MATERIALS:** Self-administered study guides emphasizing structural relationships were created for use with two online radiology atlases. Six guides (2 hours’ duration each) were created for thorax, abdomen, pelvis, head and neck, upper limb, and lower limb modules. All image modalities were employed, with emphasis on serial CT and MR images. The study guides were incorporated into a university anatomy course as an optional study component. Students self-reported which guides they completed in a course-conclusion survey. Exams were compared with

respect to completion or incompleteness of the guides. To control for variances in exam difficulty, all exams were normalized. To account for varying student aptitudes, each student served as his own control by comparing individual exam performances on modules for which students had completed the study guides against those for which they had not.

**RESULTS:** Seventy-seven of 102 students (75.5%) responded. Fifteen students completed no study guides, and 22 completed all six. Of the 40 students who completed between one and five guides, performance was significantly improved not only on radiology exams in which study guides were completed (normalized score,  $-0.03$  [48.8 percentile] vs  $-0.37$  [35.6 percentile];  $P = .002$ ), but also on the gross practical exams (normalized score,  $0.02$  [50.8 percentile] vs  $-0.24$  [40.5 percentile]). There was no significant difference in written exam scores (normalized score,  $0.04$  vs  $0.00$ , completion and incompleteness, respectively;  $P = .646$ ).

**CONCLUSION:** Self-administered study guides for radiology atlases significantly improve conceptual understanding of anatomy as measured by both radiology and gross anatomy comprehension. The guides were especially helpful to students in the lower percentiles of the class, improving their exam grades toward the class median.

**(P-10) Thursday • 7:00–8:15 AM**  
**Incidence of Local Tumor Recurrence within the Zone of Ablation Following CT-guided Percutaneous Pulmonary Cryoablation**

Christopher K. Hendrix, DO, *University of Illinois College of Medicine Peoria, OSF St Francis Medical Center, Peoria, IL*; Hamid Nazeer, DO; Bradley A. Johnson, MD; Terry M. Brady, MD (kylehendrix@juno.com)

**PURPOSE:** To retrospectively evaluate the incidence of local tumor recurrence within the ablation zone of a pulmonary tumor following CT-guided percutaneous pulmonary cryoablation.

**METHOD AND MATERIALS:** Forty consecutive patients with a total of 52 individual tumors were scheduled for CT-guided percutaneous cryoablation between May 2, 2005 and February 19, 2009. One ablation procedure was canceled, and another four patients with six tumors were lost to follow-up. A total of 35 patients (23 male, 12 female) and 45 tumors (28 primary lung cancers, 17 metastatic lesions) were followed for tumor recurrence for an average of 368 days (range, 30–1426). The average patient age was 68.5 years (range, 34–90 years). Average tumor size was 2.02 cm (range, 0.5–5.4 cm). Evaluation for tumor recurrence was accomplished by follow-up imaging using contrast-enhanced CT and/or combined PET/CT. CT criteria for tumor recurrence included evaluating for increased enhancement at the cryoablation zone, increased soft-tissue density in the ablation zone, increased size of the ablation zone after 6 months of follow-up, and peripheral ground-glass opacity surrounding the ablation zone after 6 months. PET/CT criteria for tumor recurrence included increased metabolic activity at the ablation site. All ablations were performed using an average of two cryotherapy needles (range, 1–5), with an average of two freeze-thaw cycles (range, 2–4).

**RESULTS:** The incidence of local tumor recurrence within the zone of ablation following cryoablation on follow-up studies was 22.2% (10 of 45) per tumor and 25.7% (9 of 35) per patient.

**CONCLUSION:** CT-guided percutaneous cryoablation of pulmonary tumors demonstrates promising results for successful local tumor control, with a low incidence of tumor recurrence. These results are also comparable to the results of alternative therapies for pulmonary neoplasms, including surgical excision.

**(P-11) Wednesday • 7:00–8:15 AM**  
**Graduate Medical Education Conferences: Evaluation of Presentations by Faculty and Fellows**

Kirsten P. Fredericks, BA, MS, *Indiana University School of Medicine, Indianapolis, IN*; Ronald E. Fraley, BSN, MBA; David F. Griggs, BS (kpfreder@iupui.edu)

**PURPOSE:** This study assessed needs for development of radiology fellows as educators, as one of the goals of fellowship training, investigating a perception that fellows received lower evaluations than faculty as presenters of resident conferences.

**METHOD AND MATERIALS:** Attendees evaluated 117 resident conferences during two academic years, using a 5-point Likert scale to rate

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presenters on 11 factors. Scores were analyzed for means, ranges, and standard deviations for each of two groups of presenters—faculty (101 conferences) and fellows (16 conferences)—for overall presentation scores and for each factor. Data for fellows were further grouped by residency institution (home institution, 9; or other institution, 7) and by medical school program (American medical graduate [AMG], 12; or international medical graduate [IMG], 4.)

**RESULTS:** Student's *t* test analysis showed no significant differences ( $P < .05$ ) between faculty and fellows on any of the 11 evaluation factors but revealed differences among groups of fellows. Fellows (16) averaged  $4.62 \pm 0.27$  in their overall presentation scores, while faculty (101) averaged  $4.72 \pm 0.25$ . Home residency fellows (9) scored significantly higher overall (0.34) than fellows from other programs (7) on five of the 11 factors, with ranges of 0.23–0.44 on individual factors. AMGs scored significantly better overall than IMGs in four of the 11 factors, averaging 0.40 higher (range, 0.33–0.46).

**CONCLUSION:** Analysis of evaluation data indicated significant differences among groups of fellows as presenters, not perceived differences between fellows and faculty. Higher ratings for home residency fellows and AMGs identify specific skills for targeted development. Further investigation of factors influencing lower ratings for fellows from other residency programs and for IMGs could improve the ability of the fellowship program to support the dual fellows as trainees in both clinical and educational skills. Educational interventions designed for specific groups of presenters offer potential improvement of the educational experience for both the conference attendees and for those presenting.

**(P-12) Thursday • 7:00–8:15 AM**  
**Multidimensional Approach to Assessment of Resident Training: Using All of the Tools**

Jennifer L. Steele, MS, *Indiana University School of Medicine, Indianapolis, IN*; Richard B. Gunderman, MD, PhD; James Nyce (jelsteel@iupui.edu)

**PURPOSE:** To show how the use of multiple ACGME competency-assessment tools and a competency-ranking report forms a more complete and accurate view of trainee performance. One method, faculty evaluation of residents, is often viewed as the overarching assessment of the resident, which can lead to an incomplete assessment of the total physician being trained.

**METHOD AND MATERIALS:** Multiple ACGME evaluation tools were compiled in conjunction with a resident competency report generated from a resident-tracking system. Faculty evaluations were compared with 360° evaluations and submissions of other ACGME resident required tools, such as trainee entries into portfolios, trainee evaluations of faculty, and conference attendance, to compile broader assessments of trainee performance in the program.

**RESULTS:** Additional assessment tools required by the ACGME, when included with the most often used faculty evaluation of residents, presented both expected and unexpected results. A few residents presented good medical knowledge but were not participating as required in other areas. Some residents who ranked in the middle of the trainee group participated more fully in all areas. Additionally, the ranking report showed that high-ranking residents in the medical knowledge competency were not necessarily high ranking in other competencies.

**CONCLUSION:** Using all of the assessment tools and a competency-ranking report to form a broader view of residents provides programs with a more accurate evaluation of the total physician being trained, including and beyond medical knowledge.

**(P-13) Wednesday • 7:00–8:15 AM**  
**Comparison of 18-Gauge versus 20-Gauge CT-guided Lung Biopsies: Does Size Matter?**

Kamran Ali, MD; Saad Iqbal, BS, *Kansas University Wesley Medical Center, Wichita, KS*; Kevin Baehl, MD; Akash C. Joshi, MD (siqbal@kumc.edu)

**PURPOSE:** The purpose of this study was to compare the rate of complications when using 18-gauge core biopsy needles versus 20-gauge core

biopsy needles to perform CT-guided percutaneous lung biopsies. We also assessed the efficacy of each needle in obtaining a tissue sample that yielded a pathologic diagnosis.

**METHOD AND MATERIALS:** We conducted a retrospective chart review of 332 patients who underwent CT-guided lung biopsies at our institution. These biopsies were conducted over a 3-year period from July 2006 to July 2009. Of these patients, 121 underwent biopsy with an 18-gauge core biopsy needle, and 211 patients underwent biopsy with a 20-gauge core biopsy needle. For each biopsy, the incidence of pneumothorax, the incidence of chest tube placement, and pathologic diagnosis were documented.

**RESULTS:** Our results showed that of the 121 patients who underwent an 18-gauge core biopsy, 33% ( $n = 40$ ) developed a pneumothorax; 23% ( $n = 9$ ) of patients who developed a pneumothorax required a Heimlich valve chest tube. Of the 211 patients who underwent a 20-gauge core biopsy, 51% ( $n = 107$ ) developed a pneumothorax; 35% ( $n = 37$ ) of patients who developed a pneumothorax required a Heimlich valve chest tube. The lower incidence of chest tube placement in utilizing 18-gauge core biopsy needles was statistically significant ( $P = .012$ ). A pathologic diagnosis was obtained in 93% ( $n = 112$ ) of patients who underwent an 18-gauge core biopsy. A pathologic diagnosis was obtained in 82% ( $n = 173$ ) of patients who underwent a 20-gauge core biopsy. The increased accuracy of utilizing 18-gauge core biopsy needles for lung lesion diagnosis was statistically significant ( $P = .013$ ).

**CONCLUSION:** The results of this retrospective study indicate that at our institution, 18-gauge core biopsies of lung lesions were generally safer and achieved a greater pathologic diagnostic yield when compared to 20-gauge core biopsies.

**(P-14) Thursday • 7:00–8:15 AM**  
**Perceived Benefits of a Formalized Resident Mentoring Program: Comparison of Residents with Self-selected and Assigned Mentors**

Kei Yamada, MD, *Beth Israel Deaconess Medical Center, Boston, MA*; Priscilla J. Slanetz, MD, MPH; Phillip Boiselle, MD (kyamada1@bidmc.harvard.edu)

**PURPOSE:** Mentoring is widely considered to be an important aspect of medical training, but it is controversial as to whether residents should select or be assigned a mentor. We established a resident mentoring program 4 years ago that allowed residents to either select or be assigned a mentor. The purpose of this study is to compare perceptions of the program between those who self-selected and those who were assigned a mentor.

**METHOD AND MATERIALS:** Surveys were electronically mailed to 25 radiology residents in our program who have been participating in the mentoring program for at least 1 year. Information gathered included perception of the general value of mentoring, method of assignment to mentor, length of mentoring relationship, level of satisfaction with our mentorship program, whether the residents considered their assigned mentor as their primary mentor, the perceived impact of mentoring, and likelihood of becoming a mentor in the future.

**RESULTS:** A total of 23 responses were received, for a response rate of 92%. Among the respondents, 14 selected their own mentor, and 11 were assigned a mentor. Both groups unanimously believed that mentoring is either critical or beneficial to their training as radiologists. However, those who selected their own mentors were more likely to be satisfied with the mentoring program (77% vs 30%;  $P = .04$ ), more likely to consider their mentor a "good fit" (86% vs 55%;  $P = .18$ ), more likely to consider their faculty mentor as their primary mentor (79% vs 36%;  $P = .05$ ), and more likely to become a mentor themselves in the future (54% vs 30%;  $P = .4$ ). The mean length of the mentoring relationship was similar for the two groups (2.4 years vs 1.9 years;  $P = .16$ ).

**CONCLUSION:** Radiology residents believe that mentoring is beneficial to training regardless of whether a mentor is assigned or specifically chosen. However, those residents who select their own mentors are significantly more likely to be satisfied with mentoring than those with assigned mentors. Thus, residency programs should seek ways to enhance the ability of residents to choose their own mentors.

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**(P-15) Wednesday • 7:00–8:15 AM**  
**The Corrected <sup>18</sup>FDG Standardized Uptake Value as a Biomarker for Squamous Cell Carcinoma of the Base of the Tongue**

Jessica M. Davison, BA, *Boston University School of Medicine, Boston, MA*; Devaki Shilpa Surasi, BS, MD; Rathan M. Subramaniam, MD, PhD\*; Gregory Grillone, BA, MD (rathan.subramaniam@bmc.org)

**PURPOSE:** The objective of this study was to quantify asymmetric FDG uptake in the tongue base in order to differentiate squamous cell carcinoma from physiologic uptake. We also evaluated the use of the internal carotid artery SUVmax versus that of the liver as a means to correct for background FDG uptake.

**METHOD AND MATERIALS:** A retrospective chart review was conducted of 165 patients with head and neck carcinoma and a baseline PET/CT at our institution. Thirteen patients with squamous cell carcinoma (SCC) of the tongue base were included in this study. Sixteen patients with head and neck SCC not involving the tongue base were included as controls. The tongue base SUVmax was measured bilaterally in both groups. SUVs were corrected for background uptake by dividing the SUVmax of the primary tumor or area of benign uptake by the SUVmax of the contralateral internal carotid artery to derive the corrected SUVmax (cSUVmax). The SUVmax of the primary tumor or area of benign uptake was also divided by the liver SUVmax. The SUVmax ratio was calculated by dividing the side of the tongue base demonstrating higher FDG uptake by that with lower uptake.

**RESULTS:** The mean cSUVmax  $\pm$  SD of tongue base tumors was  $10.46 \pm 6.29$ , significantly higher than benign uptake in controls ( $3.12 \pm 1.29$ ;  $P < .0001$ ). The mean SUVmax ratio between affected and unaffected sides of the tongue base in patients with SCC was  $3.70 \pm 2.26$ , higher than controls at  $1.12 \pm 0.14$  ( $P < .0001$ ). For ROC analysis using cSUVmax to differentiate benign from malignant uptake, the area under the curve (AUC) was 0.91 (95% CI, 0.82–1.02), and a cutoff cSUVmax of 3.71 had 92.3% sensitivity and 81.2% specificity. For ROC using SUVmax ratio, the AUC was 0.97 (95% CI, 0.91–1.03), and a cutoff ratio of 1.53 had 92.3% sensitivity and 100% specificity. There was a significant positive correlation between SUVmax corrected with the ICA and SUVmax corrected using liver SUV ( $r^2 = 0.87$ ;  $P < .0001$ ).

**CONCLUSION:** The SUVmax ratio is an accurate biomarker for differentiating SCC of the base of tongue from physiologic uptake. Furthermore, correlation between the SUV-to-ICA versus SUV-to-liver ratio indicates measurements from either region can be used to reduce SUV variability in the head and neck.

**(P-16) Thursday • 7:00–8:15 AM**  
**Storage of Interesting Cases in Radiology Education: A National Survey**

Michelle J. Forman, MD, *University of Maryland School of Medicine, Baltimore, MD*; Eliot L. Siegel, MD; Naomi J. Saenz, MD; Micah S. Adams, BA; Charles S. Resnik, MD (mforman@um.edu)

**PURPOSE:** Radiologists cite many reasons for highlighting interesting radiology studies for future reference in an informal manner, in addition to the need to create more-formal structured teaching files. We conducted a survey of radiologists in the United States to determine how and why they save interesting cases and to discover the ideal characteristics for an archival system. The purpose of this study is to improve our software, Study Stash, a vendor-independent program developed by our department to facilitate informal tagging, annotation, and archiving of interesting cases.

**METHOD AND MATERIALS:** A national online survey was sent to all diagnostic radiology residency programs. We incorporated responses from various levels of training and various types of radiology residency programs. Of the 148 responses received, 43% were from attendings, 11% from fellows, and 45% from residents.

**RESULTS:** Ninety-nine percent of respondents store interesting cases, most commonly for informal discussion among colleagues. Other common reasons included teaching, follow up pathology, and studying for board exams. Methods used to archive cases ranged from inefficient systems like handwriting the information in a book (16%) to using formal PACS-integrated systems (46%). While 50% save representative images, fewer save the entire series. Ease of integration into the daily work flow is an

integral component of a storage program according to 58% of those surveyed, and having a private collection of stored cases is less important (17%).

**CONCLUSION:** Study Stash, the program used at our institution, has many of the qualities cited as ideal for an informal archiving system, including ease of use without interrupting work flow. However, using survey results, we would like to enhance the program, thereby increasing the number of users and tagged cases. Implementing the results of this survey, we focus on techniques to ensure reliability of the system. In addition, we will improve the interface for each user to have access to improved organization of highlighted cases. In doing so, we aim to create a model system that other institutions can reference when creating a program to informally archive interesting cases within the work flow of a normal day.

**(P-17) Wednesday • 7:00–8:15 AM**  
**Evaluation of Imaging Requests Placed by Emergency Medicine Residents, Using the ACR Appropriateness Criteria®**

Chikaodili I. Logie, MD, *University of Maryland School of Medicine, Baltimore, MD*; Michael Bond, MD; Paul Nagy, PhD

**PURPOSE:** The emergency department is the source of a large number of imaging requests in hospitals across the country. In light of growing medical costs, a significant proportion of which are imaging costs, it behooves both ordering physicians and radiologists to ensure cost-effective imaging. In several academic institutions, residents independently order imaging studies, oftentimes relying on limited guidelines. The purpose of our study is to evaluate the imaging requests placed by ER residents in our institution, using the ACR Appropriateness Criteria.

**METHOD AND MATERIALS:** A 21-item multiple-choice assessment was administered to 37 ER residents. All years of training were represented. The assessment was based on the ACR Appropriateness Criteria, covering the most popular areas encountered in emergency medicine. These include GI/abdominal (33%), GU (10%), MSK (28.5%), and neuro-radiology and spine (28.5%). Each item presented a scenario that required residents to make the most appropriate decision regarding an imaging study. Answer choices were constructed such that there was only one best answer.

**RESULTS:** A  $\chi^2$  goodness-of-fit analysis revealed a significant relation between the type of response residents gave and the frequency with which they chose each response for 20 of the items. Of those 20 items, 20% of them were systematically incorrect. Of the 20% that were systematically wrong, three-quarters were related to abdominal imaging. Frequency of resident responses to the remaining item was not significantly related to the type of response, suggesting that a similar distribution of responses for that item could have been achieved by guessing.

**CONCLUSION:** Our findings suggest that ER residents may benefit from formal introduction to imaging decision support, including the ACR Appropriateness Criteria. We revealed that residents were systematically wrong a large percentage of the time, especially when making decisions pertaining to abdominal imaging (ie, a large number of residents made the same wrong decision). We believe that radiologists can work with non-radiologists in this respect by providing educational interventions, thereby improving physician ordering behavior.

**(P-18) Thursday • 7:00–8:15 AM**  
**Are Benign Notochordal Tumors Related to Chordomas?**

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**PURPOSE:** To evaluate the imaging, histologic, and immunohistochemical characteristics of benign notochordal tumors (BNCTs) and the possible relationship of BNCTs to chordomas.

**METHOD AND MATERIALS:** After review of whole or partial spines dissected from 259 cadavers to determine the frequency and location of BNCT and its imaging and histologic characteristics, seven patients with suspected BNCT, with and without synchronous chordomas, were studied with radiographs, CT, T1W MRI, T2W or STIR MRI, and contrast-enhanced MRI. Histology and immunohistochemistry were studied when chordoma was suspected.

\* Faculty financial disclosures are located in the Faculty Index.

**RESULTS:** At autopsy, 34 BNCTs had a similar distribution to chordomas, mainly in the clivus and sacrococcygeal region. On radiographs and/or CT of patients' and cadaveric spines, BNCT produced focally thickened trabeculae with sclerosis in affected vertebrae. Focal osteolysis was a sign of transition to incipient chordoma. Mature chordomas destroyed bone and often extended into soft tissue. At MRI, BNCTs and chordomas were T1 low signal and T2/STIR high signal with heterogeneity in chordomas with hemorrhage and/or necrosis. At contrast-enhanced MRI (patients), BNCTs showed no enhancement, whereas chordomas enhanced. At histology, BNCT was a well-demarcated unencapsulated intraosseous mass of solid sheets of eosinophilic vacuolated cells with rare atypia without myxoid matrix and with reactive sclerosis. Incipient chordoma produced focal osteolysis and intercellular myxoid matrix and/or lobular configuration with minimal atypia and sometimes with focal soft-tissue thickening or small mass. Mature chordomas showed characteristic findings with multiple lobules of cords/nests of atypical notochordal cells embedded in a rich myxoid matrix with extensive bone destruction and frequent soft-tissue mass. At immunohistochemistry, both BNCT and chordoma were positive for CK18, vimentin, S-100 protein, EMA, CAM5.2, and AE1/AE3.

**CONCLUSION:** This study suggests that BNCT may be a precursor of chordoma. In patients' and cadaveric spines, the distribution of BNCTs and chordomas and their immunohistochemical test results were similar. At imaging, osteolysis within or contiguous with BNCT signified histologically proved foci of incipient chordoma.

**(P-19) Wednesday • 7:00–8:15 AM**  
**Quantification of Normal Right and Left Ventricular Volume and Function by Multidetector ECG-gated CT**

Natalia Zarzhevsky, MD, PhD, *University of Michigan Medical System, Ann Arbor, MI*; Sivan Lieberman; Smita Patel, MBBS; Demosthenis Michaelides; Ella A. Kazerooni, MD, MS\*; Jadranka Stojanovska Nojkova, MD

**PURPOSE:** Coronary CT angiography (CCTA) is increasingly used to evaluate coronary artery disease. These ECG-gated data sets also provide ventricular function and volume. The purpose of this study is to establish CCTA-based normal reference values (absolute and indexed) for right ventricular (RV) and left ventricular (LV) volume and function, stratified by gender and body surface area (BSA).

**METHOD AND MATERIALS:** Seventy-six normal subjects (39 M, 37 F) with CCTA performed for what later proved to be noncardiac chest pain were retrospectively identified who had a normal CCTA, with no known heart disease, hypertension, or hypercholesterolemia. CCTA was performed with retrospective ECG gating on a 64-detector CT scanner. Volume analysis was performed using commercially available software by manually tracing the subendocardium of RV and LV. End-systolic volume (ESV), end-diastolic volume (EDV), stroke volume (SV), and ejection fraction (EF) were calculated. RV and LV values indexed by BSA were obtained. Linear regression analysis of data was performed, with adjustment for age, gender, body mass index (BMI), and heart rate.

**RESULTS:** Data are presented as mean  $\pm$  SD; M = male; F = female. Baseline characteristics were as follows: height (inches), M  $70 \pm 3.3$ , F  $65 \pm 3.9$ ; weight (lb), M  $193 \pm 34$ , F  $167 \pm 34$ ; BSA ( $m^2$ ), M  $2.1 \pm 0.2$ , F  $1.8 \pm 0.2$ ; BMI ( $kg/m^2$ ), M  $47 \pm 19$ , F  $47 \pm 12$ . Absolute values for RV for M were EDV,  $179 \pm 42$  mL; ESV,  $92 \pm 33$  mL; SV,  $87.5 \pm 18$  mL; EF,  $50\% \pm 7.7\%$ ; RV length,  $83 \pm 8$  mm; and RV diameter,  $44 \pm 4$  mm. Absolute values for RV for F were EDV,  $154.6 \pm 35$  mL; ESV,  $72 \pm 25$  mL; SV,  $83 \pm 12$  mL; and EF,  $54\% \pm 7.3\%$ . Mean indexed RV values (to BSA) for M were EDVI,  $93 \pm 23$  mL/ $m^2$ ; and ESVI,  $47 \pm 17$  mL/ $m^2$ ; and for F were EDVI,  $78 \pm 19$  mL/ $m^2$ ; and ESVI,  $36 \pm 13$  mL/ $m^2$ . There was a statistically significant difference between male and female RV EDVI and ESVI values ( $P = .017$ ). Similar calculations were done for LV. The age group stratification analysis is under way.

**CONCLUSION:** Normal RV and LV functional parameters vary with gender and BSA; therefore normalized reference values are needed for the use of these variables in clinical practice.

**(P-20) Thursday • 7:00–8:15 AM**  
**Comparison of Discrepancy Rates in Resident and Faculty Interpretations of On-Call PE CTs and V/Q Scans: Is One Study More Reliable during Off-hours?**

Lin Xiong; Andrew T. Trout, MD, *University of Michigan Health System, Ann Arbor, MI*; Janet E. Bailey, MD; Richard K. Brown, MD\*; Aine M. Kelly, MD, MS (atrout@umich.edu)

**PURPOSE:** Faculty and resident agreement in the interpretation of on-call studies, and specifically CTs for pulmonary embolism (PE CTs), has been demonstrated to be very good. To our knowledge, there has been no comparison of faculty and resident concordance between PE CT and ventilation-perfusion (V/Q) scans. If a significant difference exists, this could influence which study is ordered during off-hours. We compared on-call radiology resident and faculty interpretation concordance rates for PE CTs and V/Q scans.

**METHOD AND MATERIALS:** All PE CTs and V/Q scans interpreted by on-call residents from 4/2007 to 10/2008 were retrospectively evaluated. Preliminary resident reads were compared to faculty radiologists' final reads, and interobserver agreement was calculated. For discordant cases, the patient's medical records were reviewed to determine if the discrepancy was clinically significant, that is, anticoagulation was started or discontinued. Interobserver variability was also evaluated with respect to resident training level and faculty years of experience.

**RESULTS:** Interobserver agreement between residents and faculty radiologists was substantial, at 95% (1124/1183) for PE CTs ( $\kappa = 0.77$ ) and 77.9% (258/331) for V/Q scans ( $\kappa = 0.67$ ). Among discrepant cases, faculty downgraded resident interpretations in 72.9% ( $n = 43$ ) of PE CTs and 71.2% ( $n = 52$ ) of V/Q scans. While changes in interpretation were significantly more common with V/Q scans (22.1% vs 5%;  $\chi^2 < 0.0001$ ), the rates of clinically significant discrepancies were low with both modalities and not significantly different (2.1% for V/Q vs 1.2% for PE CT;  $\chi^2 = 0.2$ ). Neither the overall rate of discrepancy nor the rate of clinically significant discrepancy was related to resident training level or faculty years of experience.

**CONCLUSION:** Concordance rates for radiology resident on-call interpretation of V/Q scans and PE CTs are very good, with both demonstrating a high level of agreement with the faculty radiologist's read. While a change in interpretation is more common for V/Q scans, the frequency with which anticoagulation therapy is altered as a result of a discrepancy in either study is very low. As a result, radiology residents' preliminary interpretations should be considered reliable.

**AUR Trainee Prize: 1st Place**

**(P-21) Wednesday • 7:00–8:15 AM**  
**Using Alpha- $^{11}C$  methyl-L-tryptophan PET for Detection of Recurrence of Gliomas Treated with Surgery and Radiation Therapy**

Gautam Bahl, MD, *Wayne State University/Detroit Medical Center, Detroit, MI*; Geoffrey Barger; Sandeep Mittal; Pulak Chakraborty; William Kupsky; Csaba Juhasz, MD, RN (gautam.bahl@gmail.com)

**PURPOSE:** Alpha- $^{11}C$  methyl-L-tryptophan (AMT) is a PET tracer for imaging tryptophan metabolism through the immunomodulatory kynurenine pathway. Previous studies have shown increased AMT uptake in most malignant gliomas and glioneuronal tumors. In this study, we evaluated the role of AMT PET imaging in the detection of glioma recurrence after surgical resection and radiation therapy.

**METHOD AND MATERIALS:** Nineteen patients with previously resected malignant gliomas (WHO grade II [ $n = 4$ ], grade III [ $n = 6$ ], and grade IV [ $n = 9$ ]; including four oligodendrogliomas, four oligoastrocytomas, two astrocytomas, and nine with glioblastoma multiforme [GBM]) who had undergone postsurgical radiation therapy and who had MRI findings of possible tumor recurrence underwent AMT PET scanning. AMT uptake (evaluated 30–55 minutes after injection) was assessed visually by two of the authors. Tumor recurrence was determined by histology and/or serial MRI studies (for at least 6 months), as well as clinical progression.

**RESULTS:** Twelve of 13 patients (92%) with definite tumor recurrence had increased uptake on AMT PET. A recurrent grade 2 oligoastrocytoma showed no increased AMT uptake. Four of six patients, all with previous GBM but no evidence of tumor recurrence, had moderate increases on AMT PET around the surgical bed.

\* Faculty financial disclosures are located in the Faculty Index.

**CONCLUSION:** AMT PET imaging is highly sensitive for detection of recurrent low- and high-grade gliomas after surgical resection and radiation therapy. Increases of AMT uptake after radiation therapy may represent radiation necrosis, leading to the breakdown of the blood-brain barrier. Kinetic analysis of the dynamic AMT PET data and calculating tracer transport versus metabolic rates may further help to differentiate between areas of radiation necrosis and recurrent GBM.

**(P-22) Thursday • 7:00–8:15 AM**  
**Contrast and Resolution Analysis Using an X-ray Tube-based Diffraction-enhanced Imaging System**

Christopher A. Parham, MD, PhD\*, *University of North Carolina, Chapel Hill, NC*; Dean Connor, PhD\*; Zhong Zhong\*; Laura S. Faulconer, BS; Edda D. Pisano, MD\* (caparham@gmail.com)

**PURPOSE:** The diffraction-enhanced imaging (DEI) method is a new x-ray imaging modality that derives contrast from three different mechanisms: absorption, refraction, and ultrasmall x-ray scatter (extinction). Until recently, the technique has been limited to large synchrotron x-ray sources, but the development of an x-ray tube-based DEI system is the next step toward the implementation of a clinical DEI system. In order to determine the system properties for clinical imaging, an analysis of system contrast and resolution was performed using an imaging phantom.

**METHOD AND MATERIALS:** A DEI system was constructed using a 1-kW tungsten anode x-ray tube at 160 kV and a single monochromator/analyzer crystal pair tuned to select the  $K\alpha_1$  (59.32 keV) and  $K\alpha_2$  (57.98 keV) characteristic emission lines of tungsten. Images of 560-, 360-, 200-, and 100-micron nylon monofilaments were acquired at rocking curve positions of  $\pm 0.6$  microradians. From the two images, DEI refraction and apparent absorption images were generated. The refraction amount and the measured apparent absorption from the fibers were compared to their theoretical values. Conventional absorption-based system resolution was performed using a tungsten straightedge.

**RESULTS:** System refraction resolution was measured at 100 microns using a nylon monofilament phantom. Conventional system absorption resolution was measured at 100 microns using a tungsten straightedge. The dose used for image acquisition was 0.1 mGy. The measured contrast-to-noise ratio of the monofilaments in the apparent absorption and refraction images ranged from 2.6 and 13, respectively, in the 100-micron monofilament to 5.5 and 74 in the 560-micron monofilament.

**CONCLUSION:** These results demonstrate a design for an x-ray tube-based DEI system with a clinically useful resolution of 100 microns for both refraction and conventional absorption. The ability to generate image contrast from absorption, refraction, and extinction with a compact x-ray tube-based DEI system using high-energy x-rays is a critical step toward the development of a low-dose clinical DEI system.

**(P-23) Wednesday • 7:00–8:15 AM**  
**Awareness of Radiation Safety among Incoming 1st-Year Nonradiology and Radiology Residents**

Richard Ruchman; Faisal M. Shah, BA, MD, *Monmouth Medical Center, Long Branch, NJ*; Cole F. Mendenhall, MD; Keith Kwok; Thomas Piccoli, MD; Reza Sadeghian, BS (fmshah@gmail.com)

**PURPOSE:** To evaluate the level of knowledge and awareness regarding radiation safety as it relates to patient exposure and effective dose equivalent. This will help us determine the general knowledge that incoming residents have regarding appropriateness criteria when ordering radiologic procedures.

**METHOD AND MATERIALS:** All incoming residents who attended their initial orientation at our institution were asked to anonymously complete a questionnaire comprised of 15 questions. A total of 27 of 37 (73%) residents from various fields completed the questionnaire in 2008. The residents were supervised during the examination. Seven residents were American medical graduates, and the remaining 20 were either American-born international medical graduates (IMGs) or foreign IMGs. In 2009, 30 of 33 residents (91%) completed the survey. Twenty-eight residents were either American-born IMGs or foreign IMGs.

**RESULTS:** The results for 2008 consisted of a range of scores from 3/15 to 10/15. The median score was 6 (40%), and the mode was 7. The results

from 2009 consisted of a range of scores from 2/15 to 9/15. The median was 5.5 (37%), and the mode was 5.

**CONCLUSION:** Our results demonstrate that general knowledge and awareness regarding radiation safety issues among incoming residents are poor across a broad spectrum of residencies. Historically, radiation safety, as it relates to appropriateness criteria, has not been incorporated into the curriculum of medical students. Current U.S. medical licensure examinations do not uniformly address this topic. Our results demonstrate the need for the inclusion of elementary radiation safety education in the standard curriculum for medical students desiring to pursue further postgraduate training in the United States.

**(P-24) Thursday • 7:00–8:15 AM**  
**Quality Assurance/Improvement: Radiology Resident Experience Level Affects Discrepancy Rate for On-Call Cases**

Glenn E. Groat, BA, MD, *SUNY Upstate Medical University, Syracuse, NY*; Rolf A. Grage, MD (ggroat1@hotmail.com)

**PURPOSE:** In accordance with ACGME guidelines for practice-based learning and quality assurance/improvement (QA/QI), we developed a project examining outcome data at our institution for the prevalence of discrepant interpretations of on-call cases among radiology residents at different levels of postgraduate training.

**METHOD AND MATERIALS:** We retrospectively analyzed data for discrepant interpretations of on-call cases among radiology residents at different levels of postgraduate training (PGY-3, PGY-4, and PGY-5) between August 2008 and June 2009. On-call cases at our institution consist of all of the studies (all imaging modalities) performed on an emergent/urgent basis when the attending radiologist is not in house between 9 PM and 8 AM. A preliminary interpretation was characterized as either having a discrepancy or not. A discrepancy was defined as an attending interpretation that resulted in a change in diagnosis, treatment, or disposition that required communication with the ordering physician. We compared the discrepancy rates among the PGY-3, PGY-4, and PGY-5 residents, as well as the discrepancy rates for each PGY level over the course of the study period.

**RESULTS:** Discrepancies among all experience levels were identified in 137 (1.0%) of 14,236 cases during the study period. The discrepancy rates were highest among the residents with the least experience and trended lower among the residents with the most experience (PGY-3, 1.5%; PGY-4, 0.7%; PGY-5, 0.6%). The discrepancy rates among all of the residents at each experience level slightly decreased each quarter during the course of the study period. PGY-3 residents decreased from 4.0% to 1.2%; PGY-4 residents decreased from 0.9% to 0.6%; and PGY-5 decreased from 0.7% to 0.5%.

**CONCLUSION:** Our outcome data revealed that radiology residents at our institution, as a whole, have a low prevalence of discrepant interpretations of on-call cases; and as the level of resident training increased, the discrepancy rate decreased. QA/QI at our institution is maintained through quarterly resident education conferences reviewing/discussing discrepant interpretations.

**(P-25) Wednesday • 7:00–8:15 AM**  
**Can MR Imaging Differentiate Chromophobe Renal Cell Carcinoma and Renal Oncocytoma?**

Andrew B. Rosenkrantz, MD, *New York University Langone Medical Center, New York, NY*; Nicole Hindman, MD; Erin Fitzgerald; Jonathan Melamed, MD

**PURPOSE:** Renal oncocytoma (RO) and chromophobe renal cell carcinoma (chrRCC) are genetically related entities with overlapping histologic and molecular features; however, only chrRCC harbors malignant potential. Our goal was to assess whether conventional MRI is able to reliably differentiate these two entities.

**METHOD AND MATERIALS:** A search of the radiology and pathology registries at our institution identified 28 cases of RO and 15 cases of chrRCC imaged with MRI prior to pathologic confirmation. These cases were reviewed retrospectively and, blinded to final pathology, evaluated regarding a spectrum of MRI features, including size, location, hemorrhage,

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hemosiderin, microscopic lipid, T2 signal intensity, homogeneity, infiltrative margins, cysts, enhancement, central scar, perirenal fat invasion, and renal vein invasion. Findings were compared between the two groups using the unpaired Student *t* test and Fisher's exact test.

**RESULTS:** Both RO and chrRCC showed similar MRI features, tending to appear as well-marginated peripheral masses enhancing less than the renal cortex and with an absence of hemorrhage, lipid, cysts, renal vein invasion, or perirenal fat invasion. While there was no significant difference in the mean size of lesions in the two groups (3.5 cm for RO vs 4.1 cm for chrRCC;  $P = .51$ ), four of 15 chrRCCs had a size greater than 8 cm, whereas none of 28 ROs had a size greater than 8 cm ( $P = .01$ ). Besides this difference, none of the assessed morphologic features demonstrated a significant difference between the two entities ( $P$  values ranging from 0.11 to 1.00). A central scar, described as a classic imaging feature of RO, was present in a nearly equal fraction of each of the two groups: 11 of 28 ROs (39%) versus five of 15 chrRCCs (33%) ( $P = .75$ ).

**CONCLUSION:** RO and chrRCC demonstrated highly similar imaging findings; aside from the four chrRCCs that were greater in size than 8 cm, conventional MRI features were not able to reliably differentiate these entities. Functional MRI, such as diffusion-weighted imaging or spectroscopy, may be pursued in future studies to try to noninvasively distinguish these lesions.

#### (P-26) Thursday • 7:00–8:15 AM

##### Clinical Outcomes Following Low-Probability Ventilation-Perfusion Scans: Assessment for Clinically Significant Pulmonary Embolism

Joseph B. Broudy, MD, BS, *Beth Israel Medical Center, New York, NY*; C. Richard Goldfarb, MD; Yekaterina Nikiforova

**PURPOSE:** The Prospective Investigation of Pulmonary Embolism Diagnosis II (PIOPED II) concluded that low-probability ventilation-perfusion (V/Q) scans are nondiagnostic because of the prevalence of undetected subsegmental pulmonary emboli demonstrable on angiography. Our study seeks to assess the frequency of clinically significant pulmonary emboli in patients with low-probability V/Q scans.

**METHOD AND MATERIALS:** After receiving a letter of exemption from the institutional review board (IRB), a record was compiled including all low-probability V/Q scans performed at Beth Israel Medical Center (BIMC) during the years 2007 and 2008. In compliance with HIPAA, the medical records of these patients were then evaluated for any subsequent evidence of pulmonary embolism based on further imaging.

**RESULTS:** Of 463 patients with low-probability V/Q scans, there were no patients with subsequent imaging evidence of pulmonary embolism. One patient was found to have septic emboli on a follow-up CT.

**CONCLUSION:** Low-probability V/Q scan reliably excludes clinically significant pulmonary embolism. This raises the possibility that patients with low-probability V/Q scans who have angiographically demonstrable pulmonary embolism may not benefit from anticoagulation.

#### (P-27) Wednesday • 7:00–8:15 AM

##### Imaging Features of Solitary Fibrous Tumors from Top to Bottom

Daniel T. Ginat, MD, MS, *University of Rochester, Rochester, NY*; Aqiba Bokhari; Shweta Bhatt, MBBS; Vikram S. Dogra, MD

**PURPOSE:** Solitary fibrous tumors (SFTs) are neoplasms of mesenchymal origin, composed of spindle cells in a background collagen stroma. The diagnosis can be confirmed via positive immunohistochemical staining for CD34. The goal of this study is to determine the distribution of SFTs and characterize their imaging features on CT, MRI, ultrasound, PET, and x-ray.

**METHOD AND MATERIALS:** An IRB-approved retrospective review of 30 cases of pathology-proven SFTs in 27 patients was conducted. The imaging characteristics that were assessed include lesion size, the appearance of the margins, shape, presence of cystic or necrotic areas, intratumoral vessels, calcification, degree of enhancement, T1 and T2 signal properties, echogenicity, and degree of hypermetabolism on PET, among others.

**RESULTS:** The mean age of patients in this series was 61 years, and there was no significant gender predilection. SFTs were identified in the

pleura (53%), retroperitoneum (13%), and subcutaneous tissues (13%); and single cases each were in the liver, spine, ethmoid sinus, nasal cavity, rib, and peritoneum. The average maximum lesion dimension was 6.4 cm, and some tumors could be as large as 22 cm. All tumors were well defined, and 70% were ovoid. Only 3% had some calcification, while the remainder had no visible calcifications. On CT, almost all tumors (94%) showed some degree of enhancement, which was often heterogeneous in a whorled or cogwheel appearance, perhaps attributable to the presence of cystic or necrotic areas. The lesions had variable appearances on MRI but often showed scattered low-signal foci. Intratumoral vessels were found in 10%. The tumors were generally hypoechoic on ultrasound and had little or no hypermetabolism on PET in most cases. The lesions were malignant in 15% of cases, of which metastases were found in one case.

**CONCLUSION:** Most SFTs are benign and arise in the pleura. Nevertheless, it should be noted that these lesions can be malignant and occur in many other parts of the body. Regardless, SFTs tend to be well-defined ovoid heterogeneously enhancing lesions that lack calcification. MRI characteristically depicts low-signal foci on T1 and T2 that likely correspond to areas of dense collagen on histology.

#### (P-28) Thursday • 7:00–8:15 AM

##### US in the Diagnosis of Acute Appendicitis in Children: Experience in a Tertiary Care Hospital with a Developing Pediatric Hospital

Mohammad Reza Rajebi, MD, *SUNY Upstate Medical University, Syracuse, NY*; Linda W. Graves; Nancy Page, MSc, RN; Rolf A. Grage, MD (rajebim@upstate.edu)

**PURPOSE:** Diagnostic imaging has become an essential tool in the evaluation of children suspected of having acute appendicitis. Computed tomography (CT) is a sensitive and specific imaging technique for diagnosis of acute appendicitis. However, data show that there is a substantial risk of developing a radiation-related malignancy from a single CT scan of the abdomen. This is especially important in children, who are up to 10 times more sensitive to the effects of ionizing radiation than adults. In an effort to reduce radiation exposure, sonography has been used as an initial diagnostic examination. This retrospective study assessed current diagnostic pathways in acute appendicitis in children, with a focus on the role of imaging, particularly sonography, in a tertiary care university hospital with an establishing pediatric hospital.

**METHOD AND MATERIALS:** From 03/29/2009 to 09/21/2009, 117 patients with clinically suspected acute appendicitis were evaluated with graded compression sonography. Subsequent diagnostic and therapeutic interventions were reviewed. Results of CT and sonography were compared to surgical findings and histopathology.

**RESULTS:** A total of 18 patients had positive sonography for appendicitis, 16 (88.9%) of which were confirmed by pathology. Following inconclusive sonography, 51 patients were evaluated with CT; of these 51 patients, 11 had findings compatible with acute appendicitis, and all were confirmed by pathology. CT was negative in three confirmed cases of acute appendicitis. The remaining 37 patients with negative CT findings recovered without operations. CT was not performed in 12 patients who had inconclusive sonography and underwent appendectomy; of these 12, eight patients (75%) had confirmed acute appendicitis. Based on sonography, extra-appendiceal pathologies were diagnosed in seven patients (6%), including intussusception, ovarian cyst, ureterolithiasis, and lymphadenopathy.

**CONCLUSION:** Based on the data, we will use a diagnostic pathway for acute appendicitis in children that consists of sonography as the initial imaging technique, in combination with complementary CT in patients with inconclusive sonography, to minimize disadvantages of CT such as iatrogenic radiation exposure.

#### (P-29) Wednesday • 7:00–8:15 AM

##### Current Status of Resident-Teacher Training in Radiology: How Are We Developing the Teaching Skills of Our Future Radiologists?

Andrea Donovan, MD, *Sunnybrook Health Sciences Centre/University of Toronto, Toronto, ON* (andrea.donovan@sunnybrook.ca)

**PURPOSE:** Residents have an important role in teaching medical students and other residents. The purpose of this study was to determine the

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prevalence and structure of specific resident-teacher training opportunities within residency programs.

**METHOD AND MATERIALS:** Radiology residency program directors within the Association of Program Directors in Radiology (APDR) were surveyed via e-mail regarding specific issues related to resident lead teaching in their programs.

**RESULTS:** Of the 205 program directors surveyed, 119 (58%) responded. Approximately one-third (31%) stated that their program offers instruction to residents on teaching skills. Most of these programs (70%) were established within the last 5 years. One-half of these programs are deemed mandatory for residents to attend. The most common format consists of a one-day workshop (65%) on teaching skills, rather than a longitudinal program or educational electives. The vast majority of program directors stated that their residents are involved in teaching medical students (94%), other radiology residents (90%), and interprofessionally (67%). Approximately one-half (52%) of the residents are assigned a mentor for guidance with teaching and presentations, and one-half of the residents receive feedback about their teaching. The vast majority of program directors agreed that it is important for residents to participate in a teaching role (98%) and that teaching experiences help residents become better radiologists (85%). 94% of radiology program directors felt that the teaching skills of their residents could be improved, and 85% felt that many residents could benefit from a program that provides teacher skills training.

**CONCLUSION:** The majority of program directors value the role that radiology residents play in medical education and feel that residents would benefit from structured training to enhance teaching skills. Continued research and discussion on the topic of resident lead teaching are needed in order to establish models for developing effective teaching skills for radiology trainees.

**(P-30) Thursday • 7:00–8:15 AM**  
**“Imaging the Missing Twin”: In Search of the Postoperative Retained Object**

Kathleen D. Eggli, MD, *Pennsylvania State University Milton S. Hershey Medical Center, Hershey, PA*; Michael Hess, RT (keggli@psu.edu)

**PURPOSE:** We present a newly implemented protocol that has made the identification of retained objects after surgery easier for radiologist and surgeon alike.

**METHOD AND MATERIALS:** There were 171 digital images performed to identify a retained object following a surgical procedure. This report demonstrates a new protocol implemented in this set of patients: following the standard image with a digitally acquired image of a duplicate of the suspected retained object and placing both in the PACS.

**RESULTS:** From December 2008 through July 2009, 171 patients were imaged postoperatively for retained foreign objects. Fourteen examinations (8.2%) were positive, confirmed at immediate surgical removal. Retained objects were nine retained sponges (64.3%) and five retained needles (35.7%). There were no false-negative examinations. There was one delayed false-positive examination for a retained needle. The acquisition and PACS transfer of the additional view added less than 5 minutes to each study. Radiology technologists were compliant in imaging in 109 cases, or 64% of the total. In 62 cases (36%), they were noncompliant. The most common reason for noncompliance, in 30 cases, was an emergent “crash” surgery with no precourt. Another 12 cases were due to a count discrepancy of surgical instruments, with no specific instrument identified as being missing. In two cases, a missing instrument was found outside the body as the duplicate x-ray was begun. Subtracting these cases, 109 of 127 examinations (86%) were in compliance with the new protocol. The surgeon refused imaging once. Two noncompliant examinations were for broken instruments. In 15 cases, the technologist forgot the new protocol. The protocol change was enthusiastically accepted by radiologists and surgeons and has resulted in a higher level of confidence in interpretation reported by radiologists and surgeons, particularly in trainees. Surgeons who had been demanding 24/7 attending interpretation of all of these images have agreed that immediate attending interpretation is unnecessary in most cases.

**CONCLUSION:** Imaging a duplicate of a suspected retained object immediately postoperatively is feasible and improves confidence in image interpretation.

**(P-31) Wednesday • 7:00–8:15 AM**  
**Impact of Resident Call Eligibility on Major Discrepancy Rate**

Carl Flink, MD, *Allegheny General Hospital, Pittsburgh, PA*; Jeffrey S. Mueller, MD

**PURPOSE:** The Resident Review Committee (RRC) has recently changed the policy concerning 1st-year residents taking call. The primary goal of the study is to evaluate whether the additional 6 months of training made a significant difference in a resident’s ability to provide patient care. We evaluated the differences in theoretical patient care outcomes by examining the discrepancy rates between preliminary interpretations made by residents and final reports by attendings.

**METHOD AND MATERIALS:** All cross-sectional imaging interpreted by on-call residents (5 PM to 8 AM) during the first 6 months of call duties is reviewed for discrepant findings between the preliminary resident report and the final interpretation by an attending. Only major discrepancies are evaluated. A major discrepancy is defined as missed findings that would change patient management, such as intracranial hemorrhage, pulmonary embolism, appendicitis, etc. Major discrepancy rates are then compared between residents with 6 months of training and those with 12 months. Data subsets such as modality (CT, MRI) and subspecialty (neuro, MSK, etc) are also considered.

**RESULTS:** During the second 6 months of the 2008–2009 academic year, the on-call 1st-year residents interpreted 2752 studies while taking unsupervised call. Twenty of those were deemed to be discrepancies after the attending overread, equaling 0.73%. During the first 3 months of the 2009–2010 academic year, 2nd-year residents read 1783 studies, with 21 of those receiving discrepancies, equaling 1.2%. Additional data will be collected to complete 6 months of data for the 2009–2010 academic year.

**CONCLUSION:** Based on major discrepancy rates at our hospital, junior residents, regardless of training prior to call, provide excellent patient care. Requiring residents to have 12 months of preparation prior to taking call has not improved patient care.

**AUR Trainee Prize: 1st Place**

**(P-32) Thursday • 7:00–8:15 AM**  
**Fluoroscopy, an Often Overlooked Source of Radiation: The Effect That Level of Training Has on Patient Fluoroscopic Radiation Dosages**

Jacob K. Pirkle, MD, PharmD, *University of Tennessee Graduate School of Medicine–Knoxville, Knoxville, TN* (jpirkle@mc.utmc.edu)

**PURPOSE:** Fluoroscopy is commonly utilized for radiological studies, yet it imparts a relatively high radiation dose when compared to other modalities. Reducing patient radiation exposure is a high priority in many training programs. This study will attempt to answer the following questions: (1) Does level of training significantly affect fluoroscopy times and thus patient dosage? (2) Is a significant decrease in fluoroscopy times seen following initial training during the PGY-2 year? (3) Is there a difference in fluoroscopy times and doses at a training institution compared to national and international averages?

**METHOD AND MATERIALS:** A retrospective study was done to evaluate the impact that level of training (PGY-2 to PGY-5, radiology) has on fluoroscopy times and patient dosage at a 581-bed teaching hospital. Data from 1486 fluoroscopic exams were utilized. Patient radiation dosages and times were compared to national and international averages. Data from 1st-year (PGY-2) residents’ initial 6 months of training were compared to the second 6 months of training. Data from PGY-2 were also compared to all other years of training (PGY-3 to PGY-5).

**RESULTS:** Preliminary data indicate that for most procedures, there was a reduction in the total patient radiation dosage and fluoroscopy time when comparing 1st-year radiology (PGY-2) residents’ data from their initial 6 months of training and data from their second 6 months of training. Data also indicated a small reduction in total radiation dosage and fluoroscopy times when comparing 1st-year residents (PGY-2) to all other radiology residents (PGY-3 to PGY-5) for most procedures. When compared to international average dosages and times for the same procedures, dosages and times were generally slightly higher for radiology residents in training.

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**CONCLUSION:** Level of training appears to have a direct impact on radiation dosage and fluoroscopy procedure time for patients. In general, overall dosages at this teaching hospital were slightly higher than published national and international averages for patient dosage. Reasons for higher examination times and radiation dosages are discussed, with suggestions for lowering patient radiation exposure, in compliance with the ALARA principle.

**(P-33) Wednesday • 7:00–8:15 AM**

**“MD Notify”: A Novel Method for Increased Radiologist and Clinician Communication**

Brian D. Midkiff, MPH; Mohammed I. Quraishi, BSCE, *Saint Vincent Hospital, Worcester, MA*; Sohaib Mohiuddin, MD; Christopher J. Testa, MD; David A. Bader, MD (quraishi@gmail.com)

**PURPOSE:** PACS has increased efficiency by streamlining data collection and organization of patients’ imaging studies. However, PACS may decrease communication and personal interactions between radiologists and clinicians. To address this issue, we have instituted a novel PACS communication documentation system entitled “MD Notify.” MD Notify tracks quantitative communication between radiologists and referring clinicians.

**METHOD AND MATERIALS:** A prospective study including faculty radiologists and residents was conducted over a 2-month period from August to October 2009. Participants were asked to attach the keyword “MD Notify” whenever they contacted a member of the clinical staff to discuss the results of a study. Labeled studies were tracked, and at the end of this 2-month period, radiologists and residents were asked to fill out an anonymous online survey. In the survey, participants were asked about their level of training and their experience with MD Notify. Specifically, participants were asked, using a seven-point Likert scale, to assess MD Notify’s impact on communication with physicians, involvement with clinical care of patients, difficulty of use, disruption of work flow, and impact on work satisfaction.

**RESULTS:** The survey was completed by four faculty radiologists and seven residents. Participants reported a weekly average use of  $22.7 \pm 5.4$ . 91% strongly agreed that MD Notify was simple to learn and agreed or strongly agreed that it was worth the time commitment. 73% agreed or strongly agreed that it increased clinician contact. 91% agreed or strongly agreed that MD Notify increased rapport with clinicians. 73% disagreed or strongly disagreed that MD Notify has hindered or disrupted their work flow. 73% agreed or strongly agreed that MD Notify increased their work satisfaction.

**CONCLUSION:** MD Notify improves the amount of communication with clinicians and increases both rapport with clinicians and work satisfaction without significantly disrupting work flow. Future studies will assess the perspective of the referring clinicians regarding the impact of MD Notify.

**(P-34) Thursday • 7:00–8:15 AM**

**Utility of Maxillofacial CT Following Routine Head CT without Significant Findings of Facial Injury in the Setting of Trauma**

David J. Rossow, MD, *University of Tennessee Medical Center, Knoxville, TN*; Judson Gash

**PURPOSE:** To determine if maxillofacial CT provides significant information in trauma patients without evidence of paranasal sinus hemorrhage or orbital/intraorbital injury identified on concurrent head CT.

**METHOD AND MATERIALS:** The study was a retrospective review of patients undergoing both maxillofacial CT and head CT in the setting of trauma from January 2004 to December 2006. Exclusion criteria include paranasal sinus hemorrhage or evidence of orbital/intraorbital injury on the initial head CT. Additional exclusion criteria would include clinical concern for mandibular and maxillary alveolar ridge fractures, as these are not evaluated completely on a routine head CT at our institution. After application of exclusion criteria, 157 patients were included in the study.

**RESULTS:** No significant additional information was gained when obtaining a maxillofacial CT following a head CT without evidence of paranasal sinus hemorrhage or orbital/intraorbital injury (0/157).

**CONCLUSION:** In the setting of trauma, at our institution, there is no need for maxillofacial CT when evaluating for fractures superior to the

level of hard palate when the corresponding head CT fails to show evidence of paranasal sinus hemorrhage or orbital/intraorbital injury.

**(P-35) Wednesday • 7:00–8:15 AM**

**Missed or Delayed Diagnosis of Injuries on Trauma CT Scans: Spectrum of Injuries and Retrospective Analysis of Imaging Using the ACR RADPEER™ Grading System**

Kathleen T. Hudson, MD; Christine Ormsby, MD, *University of Tennessee Medical Center–Knoxville, Knoxville, TN*; Christy Lawson, MD; Steven Knight, MD; Brian Daley, MD; Garnetta Morin-Ducote, MD (khudson3@utmck.edu)

**PURPOSE:** The purpose of this study was twofold: (1) to determine the accuracy of CT trauma scans to detect injuries, and (2) to determine if delayed injuries were missed on initial CT trauma scan.

**METHOD AND MATERIALS:** IRB approval for this study was obtained. The records of trauma patients with CT scans performed at a level I trauma center from January 2000 to December 2008 were reviewed for delayed diagnosis of the head, cervical spine, chest, abdomen, or pelvis. Extremity injuries were excluded from this study. Hospital length of stay, type of injury missed, outcomes resulting from the missed injury, and day of detection were captured. This study was performed in conjunction with the Department of Surgery. The missed injuries were then retrospectively reviewed by two board-certified radiologists to determine if the injury could have been detected on the initial scan.

**RESULTS:** A total of 26,264 patient records were reviewed. Twenty-eight patients had a delayed diagnosis of the cervical spine, chest, abdomen, or pelvis, for an incidence of 0.11%. Previous studies in the literature demonstrated a 3% miss rate. The injuries included five delayed bowel injuries requiring surgery, three mesenteric injuries requiring surgery, six diaphragmatic injuries requiring surgery, five splenic lacerations or hematomas requiring surgery, one common bile duct injury requiring surgery, one subtle liver laceration that did not require surgery, one pancreatic contusion requiring surgery, and two pelvic fractures, one clavicle fracture, one sternal fracture, one C spine fracture, and one T1 endplate fracture which did not require additional surgery and were managed conservatively. Retrospective review of cases demonstrated that 16 cases would receive a RADPEER score of 1, eight cases a score of 2, three cases a score of 3, and one case a score of 4.

**CONCLUSION:** The accuracy of CT scans to determine trauma injuries is excellent. Our retrospective review of the missed injuries demonstrated that delayed injuries to the bowel, mesentery, and solid organs were not visible or were very subtle on initial CT scan. The MSK injuries were usually visible in retrospect, but only one required intervention.

**(P-36) Thursday • 7:00–8:15 AM**

**Falls, Older Adults, and the Trend in Utilization of CT in a Level I Trauma Center**

Bahman Roudsari, MD, PhD, *University of Texas School of Public Health, Dallas, TX*; Jeffrey G. Jarvik, MD, MPH\*; Daniel S. Moore, MD (bahman.roudsari@utsouthwestern.edu)

**PURPOSE:** Falls are the leading cause of fatal injuries in older adults, and CT is one of the most common procedures utilized in the management of these patients. This study evaluates the trend in utilization of CTs for adults  $\geq 56$  years admitted to a level I trauma center between 1996 and 2006.

**METHOD AND MATERIALS:** By linking trauma registry to billing department data and using ICD-9 procedure codes, we identified the type and frequency of CTs each patient received during hospitalization. We plotted the average number of CTs per person per year to evaluate the crude change in utilization patterns during the past 11 years. Negative binomial regression approach was used to calculate the year-specific utilization rate for different types of CT relative to the utilization rate in 1996 (baseline for comparison). We adjusted our estimates for age, gender, ethnicity, insurance status, mechanism and severity of injury, length of hospital or ICU stay, and patient disposition at the time of hospital discharge.

**RESULTS:** Between 1996 and 2006, approximately 220 patients were admitted annually to the trauma unit because of fall-related injuries in this age group. In 1996, on average, 0.34 head CT, 0.08 abdominal CT,

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0.01 thoracic CT, and 0.20 other types of CTs were performed per patient. While there was no substantial change in utilization of abdominal or thoracic CT between 1996 and 2006, the utilization of head CT and other types of CTs (including extremity and spine CTs) increased significantly to 1.6 and 0.94 per person, respectively. After adjustment for potential confounders, we found that compared to 1996, utilization of head CT was increased by 2.5-fold in 2006 (95% CI: 1.8–3.6), and utilization of other types of CTs (excluding abdomen, thorax, and kidney) increased 4.3-fold (95% CI: 2.9–6.3).

**CONCLUSION:** There has been a substantial increase in utilization of CT scans in the management of fall-related injuries among older adults. Our future studies will focus on the evaluation of potential factors associated with such an increase in utilization. In addition, we will evaluate if this increase in utilization is associated with improvements in patient outcome.

**(P-37) Wednesday • 7:00–8:15 AM**  
**Business of Radiology: Design, Implementation, and Assessment of a Curriculum for Residents**

Peter G. Stratil, MD, MBA, *University of Washington, Seattle, WA*; Jennifer R. Kohr, MD; Norman J. Beauchamp, Jr, MD, MHS\*; Jonathan R. Medverd, MD (pstratil@u.washington.edu)

**PURPOSE:** Each day, radiologists make business decisions that affect the future sustainability of their practice. Despite the importance of these decisions, radiologists are not generally trained in business principles and regulatory trends while in residency. The purpose of this study was to develop a curriculum for radiology residents that introduces these principles using business school teaching methods, as well as to determine the perceived validity of the content to the residents.

**METHOD AND MATERIALS:** In designing the curriculum, attention was paid to both the content of the material and the format in which it was presented. The content was chosen based on a survey sent to practicing radiologists. Multiple teaching styles were used over the 12-week course, including didactic lectures, small-group sessions with case studies, and panel discussions. In order to assess the validity of the content and to assess the effectiveness of each teaching style, a pretest and posttest, as well as weekly surveys, were given to the residents.

**RESULTS:** Of the 46 residents who responded to the pretest, 72% described business principles and health care policy as very important to their future careers. However, of the 15 business and policy topics listed for self-assessment, the majority of residents listed their understanding in each topic as “minimal” or “none at all.” Sessions covered a range of topics in radiology business practice and health care policy. At the time of this abstract submission, the curriculum has been finalized, and five of the 12 sessions have been completed. Initial weekly survey results show that each session is educationally valuable to the residents’ future careers and that the variety of teaching methods used helped to reinforce the principles. The remainder of the course will be completed by November 2009, with results from the posttest available by December.

**CONCLUSION:** A business and policy curriculum was deemed very important by residents and was successfully incorporated into a radiology residency. The curriculum used business school teaching styles to educate residents, and initial results show that it is educationally valuable to the residents’ future careers.

**(P-38) Thursday • 7:00–8:15 AM**  
**Estimated Additional Lifetime Risk of Cancer Attributable to Diagnostic CT in a Pediatric Bone Marrow Transplant Cohort: Experience at a Single Academic Institution**

Teresa Chapman, MD, MA, *Seattle Children’s Hospital, Seattle, WA*; Seth Friedman; Adam M. Alessio (teresa.chapman@seattlechildrens.org)

**PURPOSE:** Bone marrow transplantation in the pediatric population is complicated by infection and secondary malignancies, requiring a high frequency of diagnostic CT imaging. The known larger attributable lifetime risk of cancer after childhood exposure to diagnostic CT is of particular concern in this population, given the higher frequency of imaging

and the underlying risks due to the primary illness and constellation of complications. This study estimates the additional lifetime risk of cancer attributable to diagnostic CT in this population.

**METHOD AND MATERIALS:** IRB approval was obtained. Pediatric patients included in the study had undergone bone marrow transplantation. Dose information was collected for all diagnostic CT studies performed for each patient between August 1, 2007 and October 31, 2008 on a 64-slice multidetector CT (GE Healthcare). Dosimetry was estimated as a function of age, dose-length product (DLP), and scan region, based on published DLP-to-effective dose tables. Lifetime attributable risk (LAR) of cancer as a function of age, gender, and effective dose was derived from BEIR VII phase 2 estimates.

**RESULTS:** Forty-three patients who had undergone bone marrow transplantation were included and ranged in age from 7 months to 20 years (average age, 9 years). On average, these patients received 3.2 (range, 1–13) CT procedures following transplantation over the 15-month length of the study. Each procedure had an average effective dose of  $5.9 \pm 4.5$  mSv. These procedures resulted in an average cumulative effective radiation dose of  $20 \pm 32$  mSv to each patient, leading to an additional LAR of cancer incidence of  $5 (\pm 7)$  in 1000 and an additional lifetime attributable risk of cancer mortality of  $2 (\pm 3)$  in 1000.

**CONCLUSION:** This study provides the trends of diagnostic CT utilization in a pediatric bone marrow transplant cohort and the associated lifetime risk of cancer incidence and mortality above baseline attributable to the ionizing radiation exposure from CT. As CT procedures are increasingly being evaluated for dose reduction while maintaining diagnostic specificity, such an inquiry may be of significant assistance to this population, with the goal of decreasing lifetime cancer risk.

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## AUR 2010 Education Poster Abstracts

Education posters are located in Sapphire Ballroom B/C/F/G. Each poster will be presented by its author during *AMA PRA Category 1 Credit™* poster sessions scheduled for 7:00–8:15 AM, Wednesday and Thursday. The day and time follow the presentation number.

Presenting author is identified by institution name, city, and state (or country if not United States or Canada). Presentations by trainees (residents, medical students, or first-year fellows) are noted in blue.

### AUR Trainee Prize: 3rd Place

#### (E-39) Wednesday • 7:00–8:15 AM Abdominopelvic Applications and Imaging Appearance of Onyx Embolization Material

Mehdi Jalili, MD, *University of California, Irvine, Orange, CA*;  
Mohammad Helmy, MD; Thong Nguyen, MD; Sepideh Sefidbakht, MD;  
Allen J. Cohen, MD, PhD

**LEARNING OBJECTIVES:** 1. Understand the mechanism of function and administration of Onyx embolization material. 2. Learn potential new applications of Onyx embolization material in the abdomen and pelvis. 3. Recognize the appearance of Onyx embolization material on plain radiographic and cross-sectional abdominopelvic imaging.

**CONTENT DESCRIPTION:** Onyx is one of the new liquid embolic agents available in the United States and is commonly utilized in the treatment of intracranial arteriovenous malformations. Few case reports, primarily outside the United States, have discussed the nonneurointerventional applications of this agent. We present a series of eight patients from our institution in whom Onyx was successfully used for abdominal and pelvic embolization. We begin by reviewing the composition, mechanism of action, and administration of Onyx in therapeutic interventional radiology procedures. Abdominopelvic applications will be discussed, including treatment of (a) bleeding abdominal masses, (b) gastrointestinal hemorrhage, (c) postbiopsy hemorrhagic complications, (d) traumatic injuries, and (e) other interventions. With emerging applications of this agent in the abdomen and pelvis, it will be important to recognize the characteristics of the postprocedure embolization material on imaging. We conclude by presenting the plain radiographic and cross-sectional imaging appearance of Onyx in the abdomen and pelvis, to avoid potential misinterpretation by imagers on future studies.

#### (E-40) Thursday • 7:00–8:15 AM Recognizing Normal and Abnormal Radiographic and MR Imaging Characteristics after Anterior Cruciate Ligament Reconstruction

Hassana A. Ibrahim, MD, *UCLA Medical Center, Los Angeles, CA*  
(hassanarad@gmail.com)

**LEARNING OBJECTIVES:** 1. Foster accurate interpretation of MRI findings indicative of complications following anterior cruciate ligament (ACL) reconstruction. 2. Discuss the pathophysiology of ACL reconstruction complications. 3. Present a pictorial essay of radiographic and MRI characteristics in normal and complicated ACL reconstruction.

**CONTENT DESCRIPTION:** I. Brief overview of common graft materials used. II. Incidence, clinical symptoms, and pathophysiology of ACL reconstruction complications. III. Review of MRI findings in normal ACL reconstruction. IV. Review of MRI findings in complicated ACL reconstruction, including graft failure, graft impingement, cystic degeneration within the graft, localized anterior arthrofibrosis (cyclops lesion), postoperative infection, hardware problems, and donor site abnormalities. V. Sample cases.

#### (E-41) Wednesday • 7:00–8:15 AM Spectrum of MR Imaging Findings for Primary Central Nervous System Lymphoma

Jessica C. Tan, MD, PhD, *University of California, San Diego, San Diego, CA*; John Lyo, MD, PhD (j8tan@ucsd.edu)

**LEARNING OBJECTIVES:** Recognition of the diversity of imaging manifestations of CNS lymphoma is useful in approaching the differential

for the unknown brain lesion. An organized review of the spectrum of imaging findings on MRI, from actual biopsy-proven cases, can be helpful in future recognition and consideration of CNS lymphoma for cases with findings suggesting a different disease process. After participating in this event, the learner will have greater ability to recognize atypical presentations of primary CNS lymphoma. He or she will be more apt to include primary CNS lymphoma in his or her differential considerations. He or she will better understand underlying pathology and know how to apply advanced MRI sequences such as MR perfusion, diffusion-tensor imaging, and MR spectroscopy to aid in the diagnosis.

**CONTENT DESCRIPTION:** CNS lymphoma frequently presents a diagnostic challenge due to its nonspecific clinical course and variable imaging findings on multimodality imaging. Classically, lymphoma is thought to present as an enhancing space-occupying brain lesion with internal hypointense T2 signal, possibly with restricted diffusion and/or edema, sometimes involving the corpus callosum and/or leptomeninges. Nonstandard MRI presentations for CNS lymphoma are common and can be perplexing, as the lesion can often masquerade as another disease process, such as metastasis, demyelinating disorder, or diffuse white matter disease. At Memorial Sloan-Kettering Cancer Center, 20 patients with unusual presentations of biopsy-proven CNS lymphoma were identified, who illustrate the breadth of the protean manifestations of this relatively common disease process. MR imaging from 20 patients with atypical presentations of CNS lymphoma will be shown and discussed as a spectrum, with biopsy correlation and advanced MRI sequence (perfusion, DTI, and MRS) correlates.

#### (E-42) Thursday • 7:00–8:15 AM Pictorial Review of Soft-Tissue Calcifications

Mohammad A. Khan, MD, *University of California, San Diego, San Diego, CA*; Michael Terk, MD

**LEARNING OBJECTIVES:** 1. Review radiographic findings of a spectrum of disease entities that cause soft-tissue calcifications, including ligamentous and tendinous calcifications. 2. Discuss various presentations and mechanisms of calcification in these processes. 3. Develop a systematic approach for evaluation of soft-tissue calcifications.

**CONTENT DESCRIPTION:** Soft-tissue calcifications, including ligamentous and tendinous, are routinely seen with several different imaging modalities, including radiography, CT, and MRI. These calcifications are associated with a variety of disease processes, such as renal failure, trauma, metabolic abnormalities, tumors, and several others. Although soft-tissue calcifications may represent ancillary findings, they can provide clues to developing a differential diagnosis based on the characteristics and location within the soft tissues. In particular conditions, soft-tissue calcifications may represent the sole imaging finding, necessitating an appreciation of the mechanism and pathophysiology by which they occur. We present several cases that demonstrate soft-tissue calcifications and explain the mechanisms by which they occur, using cases and diagrams. We review soft-tissue, including ligamentous and tendinous, calcifications that occur in a variety of disease processes, ranging from familiar entities such as renal failure to more-uncommon processes such as fluorosis. After reviewing this exhibit, the reader should (a) understand the disease processes that result in soft-tissue calcifications and (b) develop a systematic approach for evaluation of calcifications on plain films, CT, and MRI.

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**(E-43) Wednesday • 7:00–8:15 AM**  
**Analysis of Mammographic Manifestations of Breast Cancer at David Grant USAF Medical Center: 2005–2009**

James B. Odone, MD, *David Grant USAF Medical Center, Travis Air Force Base, CA*; Robert A. Jesinger, MD, MS; Evan B. Moser, DO; Diane M. Lovell, MD, PhD; Adam Braithwaite, MD (robert.jesinger@travis.af.mil)

**LEARNING OBJECTIVES:** 1. Review the imaging appearances of benign and malignant breast diseases on mammograms. 2. Predict the likelihood that an imaging pattern (mass, architectural distortion, calcification) will represent breast cancer.

**CONTENT DESCRIPTION:** We would like to present an overview of the radiologic-pathologic correlations of our breast biopsies from 2005 to 2009 (over 600 cases). Our retrospective analysis of these cases (138 cancer cases, 421 noncancer cases through 2008) will divide mammographic imaging features into “mass,” “architectural distortion,” “amorphous calcification,” “coarse heterogeneous calcification,” and “branching pleomorphic calcification.” We intend to tabulate how often breast cancers had these features, as compared to benign breast disease (eg, fibrocystic change, fibroadenomatoid change, scar tissue). Our goal is to provide insight into the common manifestations and appearances of breast cancer. This work may also provide a teaching tool for future radiologists-in-training.

**(E-44) Thursday • 7:00–8:15 AM**  
**MR Imaging of Cystic Liver Lesions in the Adult: A Pattern Approach**

Sunit Sebastian, MD, *University of Mississippi, Jackson, MS*; Daniel Cornfeld, MD; Dhanpat Jain; Saravanan Krishnamoorthy, MD (saravanan.krishnamoorthy@yale.edu)

**LEARNING OBJECTIVES:** 1. Describe salient features of cystic lesions of the liver. 2. Focus on MRI features for lesion characterization. 3. Describe a pattern approach to triage lesions with overlapping features. 4. Discuss radiologic-pathologic correlation.

**CONTENT DESCRIPTION:** I. Pathology of cystic liver lesions. II. MRI features. III. Pattern approach. IV. Radiologic-pathologic correlation. V. Sample cases and impersonators. VI. Management.

**(E-45) Wednesday • 7:00–8:15 AM**  
**Mammographic Features of Expanded Lobular Units with Columnar Alteration, with Radiologic-Pathologic Correlation**

Marzieh Thurber, MD, *Mount Sinai Medical Center, Miami Beach, FL*; Stuart Kaplan, MD

**LEARNING OBJECTIVES:** 1. Understand the various mammographic characteristics of expanded lobular units with columnar alteration (ELUCA). 2. Analyze the features of ELUCA in a well-rounded context of radiologic-pathologic correlation. 3. Apply the information learned to everyday mammography interpretation.

**CONTENT DESCRIPTION:** The finding of ELUCA is being encountered with increasing frequency on core-needle biopsy of the breast. However, the radiologic diagnosis and management of ELUCA can be uniquely challenging. Current imaging modalities are not specific for differentiating ELUCA from other pathologic diagnoses, such as invasive breast cancers, and ELUCA lesions have a tendency to have appearances at mammography that are typical for ductal carcinoma in situ, resulting in high false-negative biopsy rates. Although the pathologic appearance of ELUCA has been extensively described, the mammographic appearance remains elusive. We have reviewed and summarized the imaging characteristics of patients with a pathologic diagnosis of ELUCA at our institution over the past 5 years. In our presentation, we describe the imaging characteristics that may be used to differentiate ELUCA from other more-ominous diseases of the breast. We also provide pathologic correlation to more completely describe the mammographic features of ELUCA.

**(E-46) Thursday • 7:00–8:15 AM**  
**Breast Lesions Yielding Diagnosis of Ductal Carcinoma in Situ or Ductal Atypia Following Biopsy: Elastographic Imaging Characteristics**



Todd R. Kumm, MD; Maria V. D'Alessandro, MD, *University of South Florida, Tampa, FL*; Margaret Szabunio, MD (mvelasco@health.usf.edu)

**LEARNING OBJECTIVES:** Elastography is an emerging technique that shows promise in the characterization of breast pathology. The aim of this presentation is to identify the elastography signature of ductal carcinoma in situ (DCIS) and ductal atypia (ADH). The objectives presented include (a) introduction to elastography techniques, (b) appearance of benign and malignant breast lesions using elastography, and (c) demonstrate examples of lesions which yield a pathologic diagnosis of DCIS or ADH.

**CONTENT DESCRIPTION:** Topics include examples of sonoelastography techniques, typical scoring of sonoelastography, and imaging characteristics of DCIS and ADH as seen with elastography.

**(E-47) Wednesday • 7:00–8:15 AM**  
**Review of Iatrogenic Postoperative Complications of Lung Transplantation**

Jennifer J. Neville, MS, MD, *University of South Florida, Tampa, FL*; Ammar Chaudhry, BS; Mark Rolfe, MD; Tarik Haddad, MD; Todd R. Hazelton, MD (jneville@health.usf.edu)

**LEARNING OBJECTIVES:** 1. Describe the iatrogenic complications that may occur after lung transplantation. 2. Describe the radiographic findings associated with each complication.

**CONTENT DESCRIPTION:** The infectious and immune-related complications following lung transplantation have been well documented in the radiology literature. The less-common surgery-related iatrogenic complications after transplantation have not been well described. It is important for radiologists to recognize the early radiographic findings of such complications to prevent a delay in surgical revision. In this single-center retrospective review, we analyzed 150 patients who underwent lung transplantation between 2004 and 2009. The major iatrogenic complications following lung transplantation were divided into perioperative complications, occurring within the first 30 days after transplantation, and delayed surgical complications, occurring more than 30 days after transplantation. Iatrogenic complications occurred in 7.3% (11/150) of patients in our study. The most common complication was hemidiaphragm paralysis, which occurred in both the perioperative and delayed periods. 3.3% (5/150) of patients experienced hemidiaphragm paralysis, which was unilateral in 80% (4/5) and bilateral in 20% (1/5). Three of these cases occurred in the perioperative period, and two occurred in the delayed period. Additional perioperative complications included pleurocutaneous fistula in 1.3% (2/150), bronchopleural fistula in 0.7% (1/150), and air leak in 0.7% (1/150). The following additional delayed complications each occurred in 0.7% of cases (1/150): recurrent pleurocutaneous fistula, pulmonary vein aneurysm, anastomotic stricture at the main stem bronchus, and bronchopleural fistula secondary to bronchial dehiscence.

**(E-48) Thursday • 7:00–8:15 AM**  
**The Adopt-a-Resident Radiology Development Program: An Innovative Educational Opportunity**

Ali M. Tahvildari, *Emory University, Atlanta, GA*; John Chenevey; Jay Patel, MD; Bruce R. Baumgartner, MD (atahvil@emory.edu)

**LEARNING OBJECTIVES:** 1. Describe a novel radiology resident development program. 2. Detail the impact of this program in advancing unique educational opportunities for residents and the department as a whole. 3. Outline ways to implement a similar program in other residency programs.

\* Faculty financial disclosures are located in the Faculty Index.

**CONTENT DESCRIPTION:** The Adopt-A-Resident Program at Emory University is a unique development program available to 1st-year radiology residents, which is designed to advance extracurricular academic pursuits. This original program provides the opportunity for alumni and other donors to contribute \$10,000 over the course of 4 years (\$2,500/year) for a resident to pursue an original project during their residency. Donors have the option to mentor the “adopted” resident or to remain anonymous. The annual process by which residents are selected for this program begins with the submission of a formal proposal, which includes (1) a plan for utilization of the funds during the remaining years of residency to optimize the resident’s educational experience, with specifics for the budget; (2) the resident’s potential career plans and how this program would impact on those goals in a positive way; and (3) qualities that the resident possesses that make him/her well suited for this program. The current projects supported by this program demonstrate a wide range of interests and include (1) the development of an international humanitarian radiology resident elective, (2) the use of podcasting technology to catalog and disperse lectures and other educational materials, and (3) the exploration of political and business influences on radiology. While this program is awarded to 1st-year residents, residual effects are felt throughout the department. As the years progress, this program will cultivate motivated residents with creative and innovative ideas, which in turn will enrich the educational experiences of others in the residency program and potentially the greater radiology community.

#### **(E-49) Wednesday • 7:00–8:15 AM Radiology Residency Research Track**

James R. Costello, MD, PhD, *Emory University, Atlanta, GA*; Mark E. Mullins, MD, PhD; Daniel R. Karolyi, MD, PhD; Patrick Gonzales; Brandon Fornwalt, PhD; Carolyn C. Meltzer, MD

**LEARNING OBJECTIVES:** The first objective creates a specialized research track distinguished by research time within the radiology residency curriculum. The second objective quickly incorporates the research track participants into the university research community and lets them avail themselves of its many resources of mentorship, education, and guidance. The third objective focuses on the maturation of clinical scientists with advanced clinical and research tools, with the hope of guiding these talented individuals toward careers in academic radiology.

**CONTENT DESCRIPTION:** Within the rapidly changing field of radiology, the role of the academic radiologist has assumed even greater importance. The success of an academic radiologist relies on the well-developed skills of both a clinical education and research opportunities in clinical and basic science research. The Emory research track establishes a curriculum with up to 12 months of mentored research during the 4 years of diagnostic radiology residency. Applicants are required to apply and to gain admittance to both the radiology residency and the research track. Upon admission into both programs, the resident will be guided toward the selection of an appropriate research mentor and apprised of the research community’s wealth of resources. Residents are closely monitored to ensure progression in both their clinical and research performance. On research electives, residents are required to fulfill call obligations, to attend clinical conferences, and to achieve performance goals on in-service exams, helping to ensure their professional maturation outside of the reading room. Their training will include instruction on grant preparation, institutional review board approval, manuscript writing, and building a successful academic career. Residents are strongly encouraged to submit work to peer-reviewed journals, to present at specialty conferences, and to investigate both intramural and extramural funding opportunities. In the end, the research track hopes to cultivate the careers of successful physician-scientists in radiology.

#### **(E-50) Thursday • 7:00–8:15 AM Atypical Variants of Serous Cystadenomas: A Comprehensive Review of MR Imaging Features**

Bhavika K. Patel, BS, MD, *Emory University School of Medicine, Atlanta, GA*; Bobby Kalb; Daniel R. Karolyi, MD, PhD; Juan M. Sarmiento, MD; N. V. Adsay, MD; Diego R. Martin, MD, PhD (bkalb@emory.edu)

**LEARNING OBJECTIVES:** Serous cystadenomas (SCAs) of the pancreas are benign cystic neoplasms. However, there are variant types of serous cystadenomas that may have unusual imaging features, and knowledge of these atypical SCA variants is important when formulating differential considerations for pancreatic cystic lesions. SCA variants include solid SCA, oligocystic SCA, von Hippel-Lindau–associated SCA, and serous cystadenocarcinoma. This exhibit will highlight the MR and pathologic features of typical and variant SCA to provide a comprehensive review of the MR features of SCA.

**CONTENT DESCRIPTION:** This exhibit has the following sections: overview of underlying cyst architecture and pathology of different subtypes of SCA; review of imaging methods; demonstration of MRI features of different variations of serous cystadenoma, with pathologic correlation; review of the differential diagnoses and features of each case that may suggest the diagnosis; and brief summary section highlighting the important points from the presentation.

#### **(E-51) Wednesday • 7:00–8:15 AM Turnaround Time in the Emergency Department: From Clinician Order to Electronic Report**

Kelly K. Horst, *Indiana University School of Medicine, Indianapolis, IN*; Kenneth A. Buckwalter, MD\*; Shawn D. Teague, MD\*; Daniel Altman; Lauren M. Ladd; Nicholas A. Koontz, MD (khorst@iupui.edu)

**LEARNING OBJECTIVES:** 1. Understand the ordering clinicians’ expectations, perceptions, and satisfaction regarding our department’s turnaround time for reports in the emergency department through a survey tool. 2. Evaluate the steps in the process between ordering an exam and the production of an electronic report, and identify bottlenecks within the system. 3. Compare clinicians’ expectations and perceptions with our reported turnaround times.

**CONTENT DESCRIPTION:** *Purpose:* To evaluate referring clinicians’ expectations, perceptions, and satisfaction with plain film and CT report turnaround times, and compare these with the actual measured times. A secondary goal is the identification of bottlenecks in the system.

*Method and Materials:* The study was conducted in Indianapolis at the emergency department (ED) of the Roudebush VA Medical Center, a level 3 trauma center. We surveyed clinicians over a 24-hour period regarding their ideal turnaround times, their perception of turnaround times, and what they thought were the rate-limiting steps in the system. Paper surveys were distributed on-site. 100% of physicians responded.

*Results:* Clinicians expect and perceive turnaround times of 50 min and 80 min, respectively, for plain films and 70 min and 100 min for CT. Their satisfaction averages 3.2 for plain films and 2.5 for CT on a 5-point scale. The average turnaround time is 126 min for a plain film and 169 min for CT. The perception is that the radiology interpretation step takes the longest. In reality, the longest step was the reporting time; however, the average length of time it takes the ED to enter a written order electronically is 42 minutes, only 4 minutes shorter than it takes a radiologist to produce an electronic report after viewing the images.

*Conclusion:* This study highlights the fact that referring providers perceive that turnaround time is mostly influenced by the radiology interpretation step. In our experience, the longest step was the radiologist’s reporting time, but not by a significant margin. This emphasizes the need to work collaboratively with the hospital to address turnaround time because processes outside the radiologist’s direct control influence the perception of his/her performance.

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**(E-52) Thursday • 7:00–8:15 AM**  
**Development of a Computerized Objective Structured Clinical Examination for Nuclear Medicine Trainees**

Frederick D. Grant, MD, *Children's Hospital/Harvard Medical School, Boston, MA*; S. T. Treves, MD

**LEARNING OBJECTIVES:** 1. Understand the utility and educational benefits of an objective structured clinical examination (OSCE) for nuclear medicine trainees. 2. Appreciate the educational, logistical, and technical challenges of developing a nuclear medicine OSCE.

**CONTENT DESCRIPTION:** In imaging specialties, the primary clinical output is the study report. This creates a challenge in the objective assessment of trainee performance, as the report is not the work of the resident alone. Also, faculty evaluation in the reading room is not standardized and does not assess all aspects of trainee performance. Therefore, an objective standardized clinical examination (OSCE) was developed to assess nuclear medicine trainees. The aim was to assess image interpretation and reporting within a realistic clinical context. Each examinee was presented with a requisition, clinical information, and study images for 10 nuclear medicine cases. Studies were acquired from five hospitals and presented using PowerPoint and a limited DICOM viewer on a dual-screen workstation. Seven trainees took 3–6 hours to compose a written report for each study. Anonymized reports were distributed to six faculty members and assessed using a 5-point scale to assess eight different reporting tasks, including description of technique, image interpretation, clinical correlation, impression, and composition. Examinees received feedback on performance on each case and on each reporting task. Mean examinee scores ranged between 76 and 86 (of 100). There was little correlation between trainee rank on the OSCE and performance on a standardized ABNM in-training examination. Although there was variability among scores provided by faculty evaluators, trainee rank was similar among different evaluators. Examinees reported that written faculty comments were useful and that they were challenged by limitations on image manipulation and lack of voice-recognition software. In summary, assessing nuclear medicine trainees with an OSCE requires careful case selection, computer support, and a well-organized system of review. With additional improvements and better validation, this method of trainee assessment may become a useful tool for assessing trainees in nuclear medicine and radiology.

**(E-53) Wednesday • 7:00–8:15 AM**  
**Dynamic Pelvic Floor MR Imaging of Patients Performing Manual Splinting of the Perineum**

Karen L. Wallace, MD, *Mount Auburn Hospital-Harvard Medical School, Cambridge, MA*; J. Pierre Sasson, MD; Peter L. Rosenblatt

**LEARNING OBJECTIVES:** 1. Describe pathology related to pelvic floor laxity resulting in enteroceles, cystoceles, rectoceles, and muscular dehiscence. 2. Explain the correlation between manual splinting of the perineum and its effect on pelvic floor dynamics during the Valsalva maneuver.

**CONTENT DESCRIPTION:** Dynamic MRI of the pelvis is a well-established means of evaluating pelvic floor dysfunction in women with incontinence, constipation, and dyschezia. The need for manual manipulation of the perineum, vagina, or rectum is a consistent finding among women with defects of the levator ani and prolapse resulting in incomplete evacuation. Dynamic MRI of such compensatory mechanisms may contribute useful information to clinicians in the management of patients with symptomatic pelvic floor dysfunction. The act of manual splinting, as seen with dynamic MR imaging, simulates the compensatory approaches that aid in evacuation in patients with pelvic floor weakness or prolapse. We present cases of rectoceles, cystoceles, and pelvic floor laxity that were reduced during the act of straining by using a variety of manual splinting maneuvers.

**(E-54) Thursday • 7:00–8:15 AM**  
**Characterization of Primary Rectal Gastrointestinal Stromal Tumors**

Marie Regina Koch, MD, *Brigham and Women's Hospital, Boston, MA*; Michael H. Rosenthal, MD

**LEARNING OBJECTIVES:** 1. Describe the imaging features and pattern of disease of primary rectal gastrointestinal stromal tumor

(GIST). 2. Identify features that can help to differentiate primary rectal GIST from more-common rectal tumors. 3. Describe the pathologic features and prognostic indicators of primary rectal GIST.

**CONTENT DESCRIPTION:** This poster will describe the imaging features and patterns of disease of primary rectal GIST and identify features that help to differentiate GIST from other common anorectal tumors. The pathologic features and prognostic indicators of this entity will also be described. Primary rectal GIST is rare and accounts for only 0.1% of all colorectal tumors. Rectal GISTs are commonly characterized by their expression of CD117 (KIT). This is the basis for the use of imatinib, a tyrosine kinase inhibitor that counteracts the mutant KIT and has shown efficacy in treatment of these tumors. The radiologic features of this entity are not well defined because the largest case series describes only six patients. Based on the available data, rectal GIST most commonly presents as a large, focal, round or lobulated well-circumscribed mural mass that expands the rectum. Both exophytic and intraluminal components may be present, and areas of hemorrhage can be seen within the tumor. GIST can spread via direct extension into the ischiorectal fossa or adjacent pelvic organs and may metastasize to the liver. The management of these tumors is different from that of other anorectal malignancies, so radiologic identification of these tumors is likely to be important to patient outcomes. Primary rectal GIST may be differentiated from more-common anorectal neoplasms, such as rectal adenocarcinoma, by tumor contours, features of local invasion, and patterns of regional spread of disease. Rectal GIST usually presents with well-circumscribed margins, whereas rectal adenocarcinoma presents with irregular margins. It is also unusual for rectal GIST to involve regional lymph nodes, whereas rectal adenocarcinoma and anal SCC commonly involve regional nodes. Several original cases of primary rectal GIST will be presented to illustrate these findings.

**(E-55) Wednesday • 7:00–8:15 AM**  
**Vascular Anatomy of the Spinal Cord**

Tara A. Morgan, MD, *University of Maryland Medical System, Baltimore, MD*; Gregg H. Zoarski, MD (tmorgan1@umm.edu)

**LEARNING OBJECTIVES:** 1. Review the normal extrinsic and intrinsic arterial and venous supply to the spinal cord. 2. Review major anatomic variants in spinal cord vascular anatomy. 3. Identify the extrinsic spinal cord arteries and veins angiographically. 4. Review important considerations when performing procedures, to avoid compromise of the spinal cord vascular supply. 5. Recognize when the vascular supply to the spinal cord is abnormal in angiographic appearance, such as with an arteriovenous malformation.

**CONTENT DESCRIPTION:** (1) Normal vascular supply to the spinal cord, with examples of illustrated representations and gross pathologic and angiographic images. This will include a description of the extrinsic vascular system comprised of major arteries and their contributors, their anatomic location, and anatomy of the spinal cord territory that is supplied, as well as major veins and their territory of drainage. The intrinsic vascular supply to the spinal cord which cannot be seen angiographically will also be described and demonstrated with gross pathologic and illustrated representations. (2) Variants in spinal cord vascular supply, with illustrated and angiographic examples. (3) Considerations in performing angiography and/or embolization where anastomosis with the spinal cord supply may exist. Examples are the aorta and intercostal arteries. (4) Examples of spinal cord vascular abnormalities such as an arteriovenous malformation demonstrated with angiographic images, in contrast to the angiographic appearance of normal spinal arteries and veins.

**(E-56) Thursday • 7:00–8:15 AM**  
**Beginner's Guide to Achieving a Comprehensive Teaching File System: Introduction to the Novel Synergy of myRSNA® and MIRC®**

Chikaodili I. Logie, MD, *University of Maryland School of Medicine, Baltimore, MD*; Eliot L. Siegel, MD

**LEARNING OBJECTIVES:** 1. Understand the qualities of a successful departmental teaching file system. 2. Describe the features of the

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RSNA's teaching file software (MIRC). 3. List the capabilities of the RSNA's myRSNA portal. 4. Understand the difference between MIRC and myRSNA. 5. Explain the newly released features of MIRC and how to take advantage of the novel synergy between MIRC and the myRSNA online portal.

**CONTENT DESCRIPTION:** The RSNA's myRSNA online portal provides access to various educational materials and search tools and provides free online storage for radiology images. The RSNA's teaching file software (MIRC), on the other hand, is a free and open-source means of indexing, saving, and authoring teaching files. Our goal is to formally introduce the basic steps involved in creating a robust departmental teaching file system. First, we will introduce the qualities of a successful digital teaching file system, including, but not limited to, portability, high-quality images, ability to index and search, security, support of supplemental information, easy accessibility and navigation, and adaptability. We will then proceed to introduce the RSNA's myRSNA online portal. This free service from the RSNA basically provides radiologists with access to various educational materials and search tools, as well as free online storage for radiology images. We will provide a basic review of case indexing, authoring, and sharing on MIRC, as well as new MIRC features. The differences between MIRC and myRSNA will be clarified. Finally, we will review how MIRC and myRSNA users will be able to take advantage of the novel synergy between the two systems. This includes (1) access and use of saved image files, video, and other documents stored on myRSNA's myFiles from the MIRC authoring environment; (2) access to shared media from the MIRC authoring environment; (3) export of files and MIRC documents from MIRC to myFiles on myRSNA's online portal; and (4) retrieval of exported MIRC documents from myFiles, a key component of the myRSNA online storage and indexing system. The basic steps involved in utilizing this two-way communication between MIRC and myRSNA will be emphasized.

#### **(E-57) Wednesday • 7:00–8:15 AM** **A Sound Idea for the Next Generation of Diagnostic Radiology**

Richard Reaven, MD, *University of Maryland Medical System, Baltimore, MD*; Eliot L. Siegel, MD; Rao Gullapalli, PhD; Alan McMillan, PhD (rreaven@umm.edu)

**LEARNING OBJECTIVES:** Aside from the monotone voice of the radiologist speaking into the dictation system, radiology reading rooms are surprisingly silent. We intend to challenge the current paucity of sound in the visually oriented field of radiology and to demonstrate potential applications for sound within the reading room. Human visual systems have been shown to be limited in contrast discrimination to a range of only 5–6 bits of gray-scale data. The human auditory system has the potential to detect extraordinarily subtle differences which may substantially exceed the shades of gray that can be discerned and therefore may provide additional information when it comes to interpretation of clinical and radiologic data. The learner should expect to understand the extraordinary potential applications of sound within the field of diagnostic radiology.

**CONTENT DESCRIPTION:** We have identified and explored a number of radiologic tasks in which sound may be able to provide an added benefit. The application with which we have the most experience so far involves using sound to differentiate between various regions of interest in cross-sectional imaging. We have demonstrated the feasibility of selecting regions of interest in MR images of the brain, assigning audible sounds to each homogeneous region of interest, and then reproducing those sounds in order to audibly detect the difference between CSF and white matter, for instance. Other potential applications for the role of sound in radiology include audible warnings for patients with contrast allergy or with elevated creatinine, audible alerts representing various types of important clinical data, or audible cues to guide workflow lists, such as whether a prior recommendation for follow-up was made. Our intention is to identify the tremendous potential associated with the use of sound in the radiology reading room as a diagnostic aid and work-flow tool.

#### **(E-58) Thursday • 7:00–8:15 AM** **Development of a Radiology Flight Simulator: Teaching Residents to Take the Cockpit and Fly (Safely) on Call**

Frederick E. Weiss, MD, *University of Maryland Medical Center, Baltimore, MD*; Nabile M. Safdar, MD\*; Reuben S. Mezrich, MD, PhD\*; Robert Sitarz, MD; Micah S. Adams, BA; Christopher Meenan (fweiss@umaryland.edu)

**LEARNING OBJECTIVES:** 1. Understand the simulation process and its application to the evaluation and preparation of junior radiologists for the on-call experience. 2. Describe the developmental process, including the use cases and necessary functionalities of the creation of a PACS simulator environment. 3. Understand the administrative, technical, and financial barriers related to developing a simulated radiology on-call experience.

**CONTENT DESCRIPTION:** Simulators have been used in high-risk fields such as airline travel, law enforcement, and medicine for many years. Radiology is a unique field, with heavy reliance on a computer workstation as a primary tool, involving high-risk populations in a setting such as an emergency room. Almost all patients who enter the emergency room receive some sort of radiologic examination which will have some bearing on the clinical pathway the patient will follow. This high-risk yet highly technological setting allows for a perfect educational milieu to incorporate simulation as a powerful learning tool. At our university hospital, the undertaking of the project to create a simulation workstation has brought about a design process for such a complex system, which has tremendous possibility to be generalized and customized to all hospitals with radiology residency programs. The goal of the project is to allow for a safe environment for residents to gain more experience in reading images and increase overall confidence in the radiologic and clinical decision-making process while providing a truly authentic on-call experience. Requirements for this goal and the content presented in this educational poster will detail the essential hardware (workstation, physical environment), software (PACS, availability of prior imaging and reports, voice recognition, radiology report comparison), simulation content (time management, work list development, normal vs abnormal exams), and social interactions (technologists, ED physicians, ancillary staff, report of critical findings). In addition, our proposed system to provide feedback and evaluate the performance and preparedness of the resident radiologist for the on-call experience will be presented.

#### **(E-59) Wednesday • 7:00–8:15 AM** **Implementation of a Longitudinal Residency Elective in Imaging Informatics, Quality, and Leadership: A Pilot Experience**

Jigar B. Patel, MD, *University of Maryland Medical Center, Baltimore, MD*; Nabile M. Safdar, MD\*; Charles S. Resnik, MD; Eliot L. Siegel, MD; Paul Nagy, PhD

**LEARNING OBJECTIVES:** The rapid growth of imaging informatics and an American Board of Radiology (ABR) mandate for practice quality improvement (PQI) projects have generated a critical need for resident education in imaging informatics and quality. We describe our pilot experience with an imaging informatics, quality, and leadership elective integrated into the 4th year of residency. 1. Better understand why expanded resident education in imaging informatics and quality improvement is warranted. 2. Learn about our experience in implementing a longitudinal elective in the 4th year of radiology residency addressing these needs. 3. Learn, in detail, how to implement a similar program at other institutions and how to easily integrate the elective into an existing residency curriculum.

**CONTENT DESCRIPTION:** I. Reasons for expanding residency curriculum. A. Growing role of imaging informatics in daily radiology practice. B. New ABR requirements for PQI in residency and for maintenance of certification. II. Limitations of current imaging informatics and training and lack of quality education. A. One-year postgraduate fellowship concurrent with clinical specialty fellowship; cannot be paired with ACGME-accredited clinical radiology fellowships.

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B. Dedicated 2–4-week rotation, with limited opportunities for long-term projects and narrowed scope. III. Integrated 4th-year program: one protected morning/week. A. Trainees participate in established imaging informatics and quality lecture series, technical and clinical journal clubs, roundtable discussions, and research projects. B. Covering informatics, quality, ethics, and leadership.

*Summary:* We believe this longitudinal integrated training opportunity is the first of its kind in radiology residency. The program fills the critical need of better preparing the next generation of leaders in medicine without limiting clinical fellowship training. Viewers of the exhibit will learn in detail about the curriculum, methods for integration into existing residency programs, and supporting documentation for duplicating this effort at their own institutions.

### (E-60) Thursday • 7:00–8:15 AM Breast MR Imaging Review: What the Radiology Resident Needs to Know

Zachary W. Washburn, MD\*, *University of Michigan Health System, Ann Arbor, MI*; Katherine A. Klein, MD; Mitra Noroozian, MD; Caroline P. Daly, MD; Marilyn A. Roubidoux, MD (zwashbur@umich.edu)

**LEARNING OBJECTIVES:** 1. Discuss the indications for performing breast MRI. 2. Describe breast MRI findings and enhancement curves using the BI-RADS MRI lexicon. 3. Discuss differential diagnoses and patient management based on breast MRI findings.

**CONTENT DESCRIPTION:** Breast MRI is increasingly used to screen high-risk populations and to guide clinical decision making in selected cases of known breast cancer. Knowledge of the indications for performing breast MRI and proper use of the BI-RADS MRI lexicon to describe imaging findings are essential skills that the radiology resident must acquire. The participant will review the indications for performing breast MRI, describe findings and patterns of dynamic contrast enhancement using the BI-RADS MRI lexicon, and learn differential diagnoses and MRI artifacts. Patient management based on MRI findings will also be emphasized.

### (E-61) Wednesday • 7:00–8:15 AM Pictorial Review of Nuclear Arthrography with Correlation to Surgical Findings

Paul J. Danielsky, BA, *University of Michigan Health System, Ann Arbor, MI*; Leandro Espinosa, MD; Brian Sabb, DO; John D. Blaha, MD; Richard K. Brown, MD\*; Kirk Frey (pdaniels@umich.edu)

**LEARNING OBJECTIVES:** *Background:* Nuclear arthrography is used to evaluate joint prostheses for loosening. However, the role of nuclear arthrography in patient outcomes is still unclear in the literature. Furthermore, the effect of SPECT/CT imaging in addition to traditional planar techniques has not been studied.

*Goals:* 1. Understand the technique, findings, and pearls of nuclear arthrography, including both planar acquisition and SPECT/CT imaging. 2. Describe the findings in 38 patients who had nuclear arthrograms for the evaluation of joint prosthesis loosening, with subsequent surgical and/or clinical follow-up.

**CONTENT DESCRIPTION:** *Key Issues:* (1) Review of arthrography techniques and dose administration. (2) Review of pertinent anatomy in knee, hip, and shoulder arthroplasty. Discussion of positive findings for prosthetic loosening. (3) Discussion of pitfalls in image interpretation. (4) Review of 38 patients with clinical suspicion of joint prosthesis loosening who were evaluated with nuclear arthrography. Fourteen patients had both planar and SPECT imaging. Discussion of clinical and surgical follow-up. There were 11 patients with positive findings on nuclear arthrography for prosthesis loosening. Eight of these patients underwent revision surgery and had surgical findings of loosening. Three of these patients did not undergo surgery because of other factors, such as severe depression, skin ulceration, and patient preference. There were four patients who were negative or equivocal for loosening on nuclear arthrography but had clinical and surgical findings of loosening. Additionally, two patients with negative nuclear arthrograms had laboratory-proven infected joints and subsequently underwent revision surgery. Two patients went to surgery for reasons other than loosening, such as malalignment. A total of 16 patients had revision surgery, with the remainder of patients followed clinically. There were 27

patients with negative nuclear arthrograms, 23 of which had no clinical or surgical evidence of loosening.

*Conclusion:* In this study, nuclear arthrography is a promising imaging modality to identify those patients with loose prostheses.

### (E-62) Thursday • 7:00–8:15 AM Development of a Comprehensive, Multidisciplinary, Simulator-based Training Course in Cerebral Angiography

Ellen G. Hoeffner, MD; Pamela Andreatta, PhD; Ashok Srinivasan, MD, *University of Michigan Health System, Ann Arbor, MI*; B. G. Thompson, MD (hoeffner@umich.edu)

**LEARNING OBJECTIVES:** 1. Define a basic set of cognitive standards and training guidelines in neuroangiography. 2. Define diagnostic performance standards for a cerebral angiogram and carotid angiogram on the Mentice VIST virtual-reality simulator. 3. Design a curriculum based on the cognitive standards, training guidelines, and standards of performance.

**CONTENT DESCRIPTION:** *Purpose:* To describe the development of a simulator-based training course in cervicocerebral angiography for neuro-radiology fellows, radiology residents, neurosurgery residents, and stroke neurology fellows.

*Method and Materials:* Training materials were developed in the areas of cognitive knowledge necessary to perform cervicocerebral angiography and in angiographic techniques and interpretation. These were based on current literature, standard textbooks, and the expertise of seven faculty members: five neuroradiologists and two neurosurgeons. These will be given to trainees in the form of didactic lectures at the beginning of the course. A lecture and in-service in the use of the virtual-reality simulator were given to faculty members prior to their use of the simulator and will also be given to trainees prior to their simulator use. On the simulator, two procedures were selected representing commonly encountered pathology: internal carotid artery stenosis and posterior communicating artery aneurysm. The seven faculty completed six repetitions of each case. Diagnostic performance standards were determined from this by using built-in metrics on the simulator that capture specific performance attributes. Mean performance measures for each attribute were computed, and these means were used to define the standard of performance to be reached by trainees during the course. A reviewer rating scale was also developed for assessment of trainees in the clinical context before and after simulator training.

*Results:* A virtual reality-based course in cervicocerebral angiography has been developed and is currently being implemented to instruct trainees in multiple disciplines.

*Conclusion:* This program will help trainees develop skills in cervicocerebral angiography that can otherwise be learned only in live subjects.

### (E-63) Wednesday • 7:00–8:15 AM Emergency Iatrogenic Gastrointestinal Injuries: A Multimodality Imaging Review

Richard L. Barger, Jr, MD, BA, *William Beaumont Hospital, Royal Oak, MI*; Kiran R. Nandalur, MD (richard.barger@beaumont.edu)

**LEARNING OBJECTIVES:** *Purpose:* 1. Understand several types of iatrogenic gastrointestinal injuries, including those from endogastroduodenoscopy, colonoscopy, and percutaneous catheter placement. 2. Describe the conventional radiographic, fluoroscopic, and CT findings associated with iatrogenic gastrointestinal injuries. 3. Correctly choose imaging modalities based on the clinical suspicion of the type of injury sustained.

*Conclusions and Major Teaching Points:* 1. Although bowel perforation is the most common entity, thorough evaluation of all associated structures must be performed because some findings, such as extraluminal air, can be subtle. 2. Knowledge of the timing and type of procedure is critical for the choice and interpretation of imaging. 3. Radiographs, fluoroscopy, and CT are the mainstays of imaging for iatrogenic gastrointestinal injuries.

**CONTENT DESCRIPTION:** I. Mechanisms of iatrogenic gastrointestinal injury. II. Review of radiologic findings. A. Conventional radiography. B. Fluoroscopy. C. Computed tomography. III. Sample cases. IV. Summary.

\* Faculty financial disclosures are located in the Faculty Index.

### (E-64) Thursday • 7:00–8:15 AM Creation of a Residency Conference Management Application

Jeremy S. Kendra, MD, *William Beaumont Hospital, Royal Oak, MI*; Matthias J. Kirsch, MD; Duane G. Mezwa, MD (jeremykendra@gmail.com)

**LEARNING OBJECTIVES:** 1. Describe the current Accreditation Council for Graduate Medical Education (ACGME) and Residency Review Committee (RRC) requirements and recommendations regarding resident education in regard to conference attendance. 2. Understand what residency management software (RMS) is and specifically how it can aid in the management of conference scheduling and attendance. 3. Understand how a residency program can create, using freely available tools, its own conference management application, including scheduling and attendance tracking.

**CONTENT DESCRIPTION:** *Recommendations and Guidelines:* The ACGME and RRC have developed requirements and recommendations regarding resident education and didactic instruction. The practice performance measurements suggested by the RRC for the medical knowledge competency include a learning portfolio, which is to include documentation of conference attendance.

*Residency Management Software (RMS) Choices:* While there are many RMS choices available that include conference management sections, feasible and low-cost alternatives exist for the purpose of conference scheduling and attendance tracking.

*Creation of a Residency Conference Attendance Module:* As an addition to our existing RMS, a script was created utilizing RSS, PHP, and a MySQL database to interact with data feeds from our existing online conference calendar. This new application allowed for easy analysis of collected data, including number of conferences given per category, attendance percentages per conference, and overall resident attendance. Alerts can be created to inform the program director if a resident falls below an expected attendance level.

*Results of Implementation:* Eliminating the need for time-consuming manual entry of conference attendance has significantly streamlined this process for our program coordinator. Reports are quickly and easily generated for semiannual resident evaluations, our learning portfolios, and RRC external program reviews. Overall, conference attendance has improved.

*Future Considerations:* Our current conference management script can be built on for future enhancements, including conference and presenter evaluations.

### (E-65) Wednesday • 7:00–8:15 AM “Doc, My Tooth Hurts!” CT Manifestations of Dental Emergencies

Adeel Siddiqui, MBBS, *Cooper Health, Cherry Hill, NJ*; Joshua D. Brody, DO (siddiqui-adeel@cooperhealth.edu)

**LEARNING OBJECTIVES:** 1. Understand basic dental anatomy and pathogenesis of common emergencies. 2. Differentiate nonemergent findings from emergent. 3. Recognize common patterns of dental emergencies on CT imaging.

**CONTENT DESCRIPTION:** Dental emergencies can frequently “fall through the cracks” in a busy ED setting. Whether patients present to the ED because of trauma or pain, a lot can be gained from facial bone CT scans. Dental infections, in one series, accounted for 13% of all adult patients seeking treatment by a physician. Periapical cysts are the most common and can be attributed to three main categories: endodontal, periodontal, and abscess. Endodontal disease refers to an infectious phlegmon passing through the enamel and pulp chamber into the apical region. Periodontal disease refers to infection that spreads along the gums and invades the apical region via the periodontal ligament. Dental abscesses accounted for 47% of all dental-related ER visits in a pediatric population. Osteomyelitis of the mandible can present as acute, chronic, and sclerosing forms. Acute osteomyelitis usually progresses to a lytic nonexpansile lesion with adjacent soft-tissue edema. Chronic osteomyelitis can have a variety of bony changes, with more

subtle soft-tissue swelling. Sclerosing osteomyelitis is caused by low-grade infections, which lead to an expansile lesion with bony deposition in the cortex and bony trabecula. Ludwig’s angina is a potentially life-threatening cellulitis of the floor of the mouth that causes laryngeal edema and can lead to airway compromise. The most common cause is polymicrobial dental infections. The mandible is the second most common site of facial fracture, and in the setting of motor vehicle crashes, it is the most common. While most mandibular fractures are multifocal, a substantial number of fractures can be solitary. Mandibular fractures commonly extend into the teeth. We present six relevant cases of dental emergencies, with some important “nonemergent” differentials. Along with a brief overview of dental anatomy, we hope to give the reader a basic understanding of what can make a tooth hurt.

### (E-66) Thursday • 7:00–8:15 AM Common Radiographic Signs in Abdominal Plain Film Imaging

Sara Ortiz-Romero, *Beth Israel Medical Center, New York, NY*; Sujoy Menon, MD, MBA; Robert Loree, MD; Sandor Szilagy, MD; Angela M. Yim, MD (smenon@chpnet.org)

**LEARNING OBJECTIVES:** 1. Revisit common radiographic signs of pathology in abdominal plain radiographs. 2. Briefly discuss the pathology associated with each of the signs.

**CONTENT DESCRIPTION:** Abdominal plain radiographs remain the most common initial evaluation of a patient presenting with abdominal symptoms. Some of the common radiographic signs that are encountered in abdominal plain films indicate specific pathology. Our goal is to revisit some of the most common pathological conditions, such as pneumoperitoneum, ischemic bowel, fibroids, cholelithiasis, nephrolithiasis, bowel obstruction, volvulus, and calcified abdominal aortic aneurysms. In addition, with each of these entities, we plan to discuss the associated pathology. In conclusion, we aim to create this as a valuable teaching tool for incoming radiology residents as well as for residents in other specialties.

### (E-67) Wednesday • 7:00–8:15 AM Beyond Gynecomastia: The Spectrum of Benign Breast Disease in Men

Karen B. Weinschelbaum, MD, *Montefiore Medical Center, Bronx, NY*; Tova C. Koenigsberg, MD (kweinshe@montefiore.org)

**LEARNING OBJECTIVES:** 1. Describe the components of the male breast. 2. Describe the spectrum of benign breast disease in men. 3. Recognize the mammographic and sonographic appearances of benign breast disease in men, beyond gynecomastia.

**CONTENT DESCRIPTION:** Mammograms of the male breast are most commonly performed for clinical symptoms of focal pain or a palpable finding. In most cases, mammography demonstrates benign gynecomastia, and occasionally a diagnosis of male breast cancer is made. However, there are other benign findings that may be present on mammography, arising either from the male breast parenchyma or from the skin and subcutaneous tissues. It is important to be aware of these other benign entities beyond gynecomastia and to recognize their mammographic and sonographic appearances.

### (E-68) Thursday • 7:00–8:15 AM Interactive Radiology Education Cooperative Network (iRECoN): An Innovative Way to Improve Resident Education

Cameron Hassani, MD, *Long Island College Hospital, Brooklyn, NY*; Young Song, MD; Deborah L. Reede, MD; Tsz Ng, MD

**LEARNING OBJECTIVES:** Radiology residency programs currently face major financial constraints and are becoming more cost-conscious with regard to resident education. Development of teleconference educational series by a consortium of radiology residency programs will standardize and improve the quality of resident education and reduce associated cost (direct and indirect). Learning objectives are to educate and to demonstrate the efficacy of utilizing

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teleconferencing in order to: (1) pool physician educator and case resources, (2) improve and standardize resident training, (3) fulfill RRC didactic lecture requirements, and (4) reduce costs allocated for resident education.

**CONTENT DESCRIPTION:** I. Introduction. II. Discussion of technical requirements and cost. III. Participant selection. IV. Demonstration of applications. V. Analysis of various educational formats (case-based, didactic, and individual tutorials). VI. Conclusion: based on personal observations and the analysis of surveys sent to participating institutions' program directors and residents before and after the introduction of teleconferences for resident education.

**(E-69) Wednesday • 7:00–8:15 AM**  
**Endometriosis of Abdominal and Pelvic Wall Scars: Multimodality Imaging Findings, Pathologic Correlation, and Radiologic Mimics**

Rita Gidwaney, MD, *Winthrop-University Hospital, Mineola, NY*; Ruth L. Badler, DO; Benjamin Yam, BS; John Hines, MD; Vlada Alexeeva; Douglas S. Katz, MD; et al (dkatz@winthrop.org)

**LEARNING OBJECTIVES:** Endometriosis affecting pelvic and abdominal wall scars, especially following cesarean section, is an uncommon but well-described condition. Radiologists may not necessarily consider the diagnosis, however, when the findings are encountered on imaging studies. This exhibit will review the imaging, pathology, and clinical features of this condition.

**CONTENT DESCRIPTION:** From our clinical practice over the past few years, multiple cases of endometriosis affecting the anterior abdominal and pelvic wall in the region of surgical scars will be demonstrated, using CT, US, and MR imaging. MR imaging is particularly helpful, as subacute to chronic blood products in the correct clinical context should strongly suggest the diagnosis. Correlative pathology will be shown, and the radiologic differential diagnosis will be reviewed, along with the clinical and imaging literature on the topic. When an abdominal and/or pelvic anterior wall mass or area of soft-tissue thickening is encountered on cross-sectional imaging examinations in a woman, in the correct clinical context, endometriosis should be considered prospectively by the interpreting radiologist. CT, US, and particularly MR imaging may be complementary for suggesting or establishing this diagnosis. Alternative diagnoses, such as desmoid tumor/fibromatosis, should also be considered in the differential diagnosis.

**(E-70) Thursday • 7:00–8:15 AM**  
**Pediatric Renal Tumors: CT, MR Imaging, and Clinical-Pathologic Correlation**

John Hines, MD, *Long Island Jewish Medical Center, New Hyde Park, NY*; Mark E. Bittman, MD; Jeanne Choi-Rosen; Dan M. Barlev, MD; Douglas S. Katz, MD; Anita P. Price, MD; et al (jhines@lij.edu)

**LEARNING OBJECTIVES:** 1. Review both common and rare pediatric renal masses. 2. Detail and discuss pertinent clinical associations which are characteristic of specific renal tumors. 3. Review Children's Oncology Group (COG) imaging protocols.

**CONTENT DESCRIPTION:** The presentation will be in didactic format, covering the CT, MR, and US findings of various common and rare pediatric renal masses, both malignant and benign. Cases will include Wilms tumor (favorable and unfavorable tumors, as well as bilateral tumors, and common and less-common imaging findings/presentations, as well as their associations), renal lymphoma, renal medullary carcinoma, rhabdoid tumor of the kidney, PNET of the kidney, nephroblastomatosis, and renal angiomyolipoma. Pathologic correlations will be presented, and the clinical associations, differential diagnoses, and current COG imaging protocols will be discussed. Additionally, cystic masses/mass-forming processes of the pediatric kidney will also be demonstrated and discussed. On completion of the presentation, the viewer should have an understanding of the different imaging features, clinical associations, and current opinions on imaging follow-up for various renal masses, both malignant and benign, which can affect the pediatric population. The reader should be able to recognize both common and rare pediatric renal tumors.

**(E-71) Wednesday • 7:00–8:15 AM**  
**CT of the Skin**

Douglas S. Katz, MD, *Winthrop-University Hospital, Mineola, NY*; George Ganson, MD; Michelle Klein; Joseph P. Mazzie, DO (dkatz@winthrop.org)

**LEARNING OBJECTIVES:** The purposes of this exhibit are to (a) remind the radiologist to examine the skin on all CT images of the chest, abdomen, pelvis, and lower and upper extremities; (b) present the spectrum of skin findings which can be identified—either incidentally or related to the reason(s) for imaging—on CT; and (c) briefly review the relevant literature and the differential diagnosis for skin findings/pathology on CT.

**CONTENT DESCRIPTION:** A series of case examples from our recent clinical practice will be demonstrated, where skin findings on CT were identified, either incidentally or related to the reason(s) for the examination. These include hematoma related to trauma and/or anticoagulation; other traumatic injuries; infectious processes, including abscess, cellulitis, and necrotizing fasciitis; edema related to anasarca and/or lymphedema; fistulas; gas related to barotrauma; postsurgical changes, including those after liposuction; foreign bodies; benign lesions/neoplasms, including sebaceous cysts, scars, keloids, and neurofibromas; and malignant lesions, including metastases and T-cell lymphoma. The relevant CT literature will be briefly reviewed, and the differential diagnosis discussed.

**(E-72) Thursday • 7:00–8:15 AM**  
**Preoperative US Localization of Foreign Bodies, with Postoperative Pathologic Correlation**

Luke R. Scalcione, MD, *Winthrop-University Hospital, Mineola, NY*; Jonathan S. Luchs, MD

**LEARNING OBJECTIVES:** Using an interactive PowerPoint program, the exhibit will review the sonographic findings of various foreign bodies that are often radiographically occult (wood, plastic, glass, and thin metallic shavings). We will demonstrate five cases from our institution utilizing ultrasound for preoperative localization of foreign bodies within the extremities. The postoperative pathologic specimens for each case will be presented and correlated with preoperative ultrasonographic examinations.

**CONTENT DESCRIPTION:** Foreign bodies such as wood, plastic, glass, and thin metallic shavings may often be radiographically occult. Blyme et al demonstrated a sensitivity and specificity of 89% and 93%, respectively, for sonographic detection of various foreign bodies. The intent of this exhibit is to review the significant sonographic findings for detection and localization of various foreign bodies and their impact on the surgical patient.

**(E-73) Wednesday • 7:00–8:15 AM**  
**The Atypical Appendix**

Bruce Javors, MD\*; Helen T. Morehouse, MD; Vladimir Merunka, BS; Douglas S. Katz, MD, *Winthrop-University Hospital, Mineola, NY* (bjxraydoc@verizon.net)

**LEARNING OBJECTIVES:** 1. Be more familiar with the normal and abnormal development of the appendix, as well as a variety of unusual disorders that may affect the appendix which can be identified on CT and barium examinations. 2. Be more familiar with the various less-common and rare pathologies that can affect the appendix.

**CONTENT DESCRIPTION:** The purpose of this exhibit is to acquaint the viewer with the many variations of development and position of the appendix, which may lead to atypical appearances on CT and barium examinations. The exhibit will also demonstrate a broad spectrum of disease entities which may involve the appendix, beyond the usual acute appendicitis. Abnormal appendiceal positioning, including malrotation and situs inversus, will be demonstrated for both the normal and abnormal appendix. Appendiceal location in the subhepatic region, as well as in Amyand's and other hernias, will also be shown. A fetal appendix will be discussed and demonstrated. Cases of appendicitis secondary to Crohn's disease, pseudomembranous colitis, mucocele, carcinoid, adenocarcinoma, and other conditions will be

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demonstrated. Unusual conditions, including appendiceal diverticulosis and intussusception, will also be demonstrated. Complicated appendicitis, including chronic presentations, intussusception, pylephlebitis/liver abscess, and diverticulitis, will also be reviewed. The relevant literature will also be discussed.

**(E-74) Thursday • 7:00–8:15 AM**  
**The Incidental Postmenopausal Adnexal Cyst: “Oh, No, What Should I Recommend?”**

Ryan B. Viets, MD; George E. Lynskey III, MD; Stacey O. Verzosa, BA, MD, *Beth Israel Medical Center, New York, NY* (rviets@chpnet.org)

**LEARNING OBJECTIVES:** 1. Know the incidence of postmenopausal adnexal cysts and the likelihood of malignancy in such a cyst. 2. Describe the recommended follow-up for postmenopausal adnexal cysts. 3. Understand which features are worrisome for malignancy and which likely indicate benignity.

**CONTENT DESCRIPTION:** The increasing use of CT of the abdomen and pelvis has led to many incidental findings, one of which is a cystic lesion on the adnexa in a postmenopausal woman. The first section of the poster will describe the prevalence and differential diagnosis for postmenopausal adnexal cysts. The second section will deal specifically with simple adnexal cysts (<5 cm and fluid-attenuating). It will list the presumed pathophysiology for such cysts and outline the suggested management. CT examples of these cysts with ultrasound correlates will be provided. The third section will show examples of more-complex postmenopausal cysts, including multilocular cysts and cysts with solid components. Management of these lesions will be discussed. A final conclusion section will list the simple recommendations, depending on the characteristics of the cystic lesion.

**(E-75) Wednesday • 7:00–8:15 AM**  
**Hysterosalpingograms from A to Z**

Ryan B. Viets, MD, *Beth Israel Medical Center, New York, NY*; George E. Lynskey III, MD (rviets@chpnet.org)

**LEARNING OBJECTIVES:** 1. Recognize the indications for a hysterosalpingogram (HSG). 2. Understand the steps involved in a typical HSG, and have a basic idea of how to perform an HSG. 3. Be able to identify a normal HSG, as well as some common abnormalities encountered on HSG.

**CONTENT DESCRIPTION:** Hysterosalpingograms (HSGs) are relatively simple procedures which can be performed by any radiologist with the assistance of a fluoroscopic technician. At our institution, no obstetrician/gynecologist is present, and the radiologist inserts the speculum and infusion catheter. It is important for the radiologist to be adept at performing this quick yet important procedure, especially given the increasing numbers of obstetricians/gynecologists who are performing HSGs without the help of a radiologist. This poster will describe an HSG and the indications for one. There will be step-by-step instructions for performing an HSG, with photographs and text. These will include instructions for inserting the speculum into the vagina and catheterizing the uterus. The poster will demonstrate the proper use of the tenaculum, in case one is required. Finally, the poster will show an example of a normal HSG, including oblique digital images of contrast spilling around bowel loops in the peritoneal cavity. Subsequently, common abnormalities encountered on HSGs will be discussed, utilizing HSG images. These abnormalities include Asherman’s syndrome, uterine malformations, tubal occlusions, and hydrosalpinx.

**(E-76) Thursday • 7:00–8:15 AM**  
**Radiographic-Pathologic Evaluation of Phyllodes Tumor of the Breast: A Brief Review of This Rare Tumor**

Shanon M. Connolly, MD, *New York-Presbyterian Hospital/Cornell University, New York, NY*; Kemi T. Babagbemi, MD

**LEARNING OBJECTIVES:** 1. Understand the radiographic and clinical features of benign versus malignant phyllodes tumors. 2. Understand how mammography, sonography, MRI, and PET/CT each contribute to the work-up of malignant phyllodes tumor of the breast. 3. Describe an algorithm for management of phyllodes tumors, including radiographic and clinical follow-up.

**CONTENT DESCRIPTION:** Phyllodes tumor is a rare fibroepithelial breast tumor which accounts for approximately 1% of all breast tumors. We will briefly review clinical and radiological features of benign versus malignant phyllodes tumors. A case of recurrent metastatic malignant phyllodes tumor of the breast in a middle-aged woman will be presented, and imaging features will be reviewed utilizing mammography, sonography, MRI, and PET/CT with pathologic correlation. Finally, we will review the essential role of imaging in predicting malignancy grade to appropriately direct further management.

**(E-77) Wednesday • 7:00–8:15 AM**  
**Incidental Breast Findings on CT Scans**

Laura S. Sheiman, MD, *New York-Presbyterian Hospital/Weill Cornell Medical Center, New York, NY*; Kevin W. Mennitt, MD

**LEARNING OBJECTIVES:** 1. Recognize common implantable breast devices on CT scans. 2. Recognize the appearance of postoperative breast findings on CT scans. 3. Identify incidental breast masses on CT scans, and learn appropriate follow-up management options.

**CONTENT DESCRIPTION:** Although computed tomography (CT) is not considered the first-line exam for evaluating the breast, radiologists are frequently presented with incidental breast findings on CT scans. First, we will present examples of commonly encountered implantable breast devices. For example, breast brachytherapy devices, breast prostheses, and breast expanders should be recognized by the radiologist. Next, we will explore postoperative/postbiopsy findings in the breast on CT scans. Many patients will require a chest CT scan in the postoperative period, and it is imperative that the radiologist accurately identify postoperative findings so as to not confuse them with acute pathology. Lastly, we will provide examples of benign and malignant masses incidentally seen on CT scans. Although there has been prior research on benign and malignant features on CT scans, current recommendations support further evaluation with either mammography or ultrasound. We will briefly review these characteristics, as well as recommendations for further imaging.

**(E-78) Thursday • 7:00–8:15 AM**  
**Orbital Fractures: What the Ophthalmologist Really Wants to Know**

George E. Lynskey III, MD, *Beth Israel Medical Center, New York, NY*; Ryan B. Viets, MD

**LEARNING OBJECTIVES:** 1. Identify and describe the clinical features of orbital fracture and its complications as seen on CT. 2. Explain the critical information needed by the ophthalmologist when evaluating a patient with an acute orbital fracture. 3. Discuss the common missteps made in the interpretation of orbital fractures on CT as viewed by the ophthalmologist.

**CONTENT DESCRIPTION:** Orbital fracture is a common entity seen by residents on call. The CT scan of the orbit cannot be read in a vacuum, as the radiologist may both over- and undercall pathology. Knowing the questions the ophthalmologist has when ordering the scan can help a radiologist tailor the report to include the pertinent findings needed for prompt treatment of these emergencies. Both CT and clinical correlates will demonstrate that appearances on CT both over- and underestimate the extent of the injury when compared with the physical exam.

**(E-79) Wednesday • 7:00–8:15 AM**  
**Zebras in the Brain: Adult Infratentorial Parenchymal Tumors**

J. Levi Chazen, MD, *New York-Presbyterian Hospital/Weill Cornell Medical College, New York, NY*; Clifford D. Phillips, MD\* (jlc2008@nyp.org)

**LEARNING OBJECTIVES:** 1. Identify and differentiate imaging characteristics of intraaxial infratentorial malignancies that arise in adults. 2. Understand the role of advanced imaging techniques, such as diffusion-weighted imaging, as tools in the diagnosis of posterior fossa lesions. 3. Identify anatomic landmarks of the posterior fossa, and understand histologic cell types that can give rise to neoplasms.

**CONTENT DESCRIPTION:** Infratentorial neoplasms are unusual in adults, accounting for only 30% of all intracranial malignancies. Most

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of these lesions are extraaxial, such as schwannomas and meningiomas. Posterior fossa parenchymal lesions are a distinct and important subset that many radiologists in training struggle to identify. This poster will present the imaging characteristics of intraaxial posterior fossa neoplasms that arise in adults. The following will be considered: astrocytic tumors (astrocytoma, glioblastoma multiforme), embryonal tumors (medulloblastoma), neuronal and mixed glial tumors (ganglioglioma, cerebellar liponeurocytoma), hemangioblastomas, and metastases. Each malignancy will be illustrated with multiplanar imaging and will feature a discussion of unique multisequence imaging characteristics. A brief overview of posterior fossa anatomy and histology will be included, and special mention will be made of diagnostic pearls, differential considerations, and common imaging pitfalls.

**(E-80) Thursday • 7:00–8:15 AM**  
**Orbital Inflammatory Disease: A Succinct Overview for the On-call Radiology Resident**

Elena Bukanova, BS, *Weill Cornell Medical College, New York, NY*;  
 J. Levi Chazen, MD; Clifford D. Phillips, MD\* (enb2002@med.cornell.edu)

**LEARNING OBJECTIVES:** 1. Identify imaging characteristics of common causes of orbital inflammatory disease, and generate a differential diagnosis based on these findings. 2. Differentiate orbital inflammatory disease from common imaging mimics such as orbital lymphoma and PTLD.

**CONTENT DESCRIPTION:** Orbital inflammatory disease (OID) involves one or multiple structures located within the orbit and encompasses a variety of clinical presentations and pathologic processes. Many of these disease processes are seen by practicing radiologists and are of particular importance in the emergency setting. Imaging alone is not always sufficient to definitively differentiate among infectious, immune-mediated, and neoplastic etiologies of OID. However, the use of CT, MRI, and ultrasound, in the setting of a careful history and physical examination, can be crucial in establishing the likely diagnosis and directing treatment by assessing the extent of disease, identifying possible complications, and monitoring response to therapy. This poster will provide a succinct overview of the common causes of OID and illustrate radiographic findings useful in narrowing the differential diagnosis. Focus will be on idiopathic orbital inflammation (orbital pseudotumor), thyroid-associated orbitopathy, sarcoidosis, Wegener's granulomatosis, Tolosa-Hunt syndrome, and Kimura disease. Additionally, a comparison will be made with common mimics, including orbital lymphoma, post-transplant lymphoproliferative disorder (PTLD), and orbital cellulitis—and important differentiating clues will be emphasized.

**(E-81) Wednesday • 7:00–8:15 AM**  
**Proximal Femoral Focal Deficiency: Multimodality Review of Findings, Classification, and Treatment**

Matthew R. Amans, MD, MS, *Weill Cornell University School of Medicine, New York, NY*; Kevin W. Mennitt, MD (drmatty01@yahoo.com)

**LEARNING OBJECTIVES:** 1. More accurately diagnose proximal femoral focal deficiency (PFFD) based on radiographic analysis. 2. Present possible uses for ultrasound and MRI in the assessment and therapeutic treatment planning for PFFD. 3. Review common therapeutic options for PFFD.

**CONTENT DESCRIPTION:** PFFD is a rare congenital malformation consisting of a spectrum of findings affecting the femur and pelvis. Therapy is highly individualized and requires an interdisciplinary approach, often with the radiologist playing an integral role in the team.

**Radiographic Analysis:** (1) Femur: short femur, delayed or no femoral capital ossification, and misshapen femoral head, neck, and coxa vara. (2) Pelvis: dysplastic acetabulum, horizontal acetabular roof, enlarged obturator foramen, and supra-acetabular bump.

**Utilization of Ultrasound and MRI:** Originally, it was proposed to use ultrasound and MRI to allow for earlier classification and, subsequently, earlier therapeutic intervention. However, the acetabulum does not form without a femoral head. Perhaps the role of ultrasound and MRI is to al-

low for characterization of the lower extremity musculature and to allow for more individualized surgical intervention and prosthetic design.

**Review of Common Therapeutic Options:** (1) Limb-lengthening procedures. (2) Limb length equaling prosthesis. (3) Syme amputation with prosthesis. (4) Modified Van Nes procedure.

**(E-82) Thursday • 7:00–8:15 AM**  
**Lower Extremity Edema: Alternative Diagnostic Causes in the Setting of Negative Results for Deep Venous Thrombosis**

Peiweng Chen, MD, *New York-Presbyterian Hospital/Weill Cornell Medical College, New York, NY*; Keith D. Hentel, MD, MS; Lily Belfi, MD (peiwenchen@gmail.com)

**LEARNING OBJECTIVES:** Review the imaging characteristics of common diagnostic mimics of DVT in the acute setting, which include ruptured popliteal cysts, superficial thrombophlebitis, muscle hematomas, tendon injury, and infection (cellulitis, necrotizing fasciitis, and abscess).

**CONTENT DESCRIPTION:** Patients with deep venous thrombosis (DVT) often present with leg swelling, leg discomfort, discoloration, or a palpable cord; however, none of these signs or symptoms are specific. Much emphasis has been placed on the diagnosis of DVT owing to the serious risk of pulmonary embolism. In a recent case series evaluating the effectiveness of sonography in diagnosing DVT, an alternative pathology was identified in approximately 15% of patients. In patients with clinically suspected DVT, the recognition of alternative pathology is paramount in order to avoid erroneous and potentially harmful medical therapy. Although evaluation and management are often guided by history and physical examination, a diagnostic study is often required. It is therefore the radiologist, using a variety of imaging modalities (US, CT, MR), who is often called on to confirm the true diagnosis. Familiarity with the imaging work-up and findings of alternative causes of lower extremity edema and injuries is necessary for any radiologist in the acute setting. The purpose of this poster is to present and review the imaging characteristics of common diagnostic mimics of DVT in the acute setting, which include ruptured popliteal cysts, superficial thrombophlebitis, muscle hematomas, tendon injury, and infection (cellulitis, necrotizing fasciitis, and abscess).

**(E-83) Wednesday • 7:00–8:15 AM**  
**Preoperative Evaluation of Vascularized Fibular Grafts**

Robert Loree, MD, *Beth Israel Medical Center, New York, NY*; Sujoy Menon, MD; James E. Silberzweig, MD (rllore@chpnet.org)

**LEARNING OBJECTIVES:** 1. Understand some of the common indications for a vascularized fibular graft. 2. Understand the optimal vascularized fibular graft conditions on angiography, as well as additional modalities such as MRA, for a successful harvest.

**CONTENT DESCRIPTION:** The use of free fibular grafts has been well reported for the treatment of various conditions. These include mandibular reconstruction after surgery for head and neck tumors, treatment of early avascular necrosis of the femoral head, reconstruction of long bone defects resulting from tumor resection or trauma, nonunion of tibial fractures, and long bone pseudarthrosis. The most serious consequence of fibular flap transfer is the lack of collateral circulation with the foot, leading to ischemia following interruption of the peroneal artery. The preoperative vascular conditions that will adversely affect the harvest of the vascularized fibular graft are (1) significant arteriosclerotic disease within the tibial-peroneal vessels, (2) traumatic occlusion of the tibial-peroneal vessels, (3) absence or diminutive anterior or posterior tibial arteries, in which case the peroneal artery is the major arterial supply to the foot, (4) absence of the peroneal artery, either congenitally or as an acquired defect, (5) low tibial trunk bifurcation, and (6) deep venous thrombosis. Traditionally, angiography has been the preferred modality for the evaluation of vascularized fibular grafts; however, MRA has also been shown to provide comparable definition of the arterial anatomy of the lower extremities. Recently, the possibility of deep venous thrombosis as a potential further complication has led to further discussion of the usefulness of evaluating the venous system.

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**(E-84) Thursday • 7:00–8:15 AM**  
**Exploring the Controversies of Central Venous Catheter Tip Position, with Review of Cavoatrial Junction Location on Chest Radiographs**

Bradley B. Pua, MD, *New York-Presbyterian Hospital/Weill Cornell Medical School, New York, NY*; Paula W. Brill, MD (brp9018@nyp.org)

**LEARNING OBJECTIVES:** 1. Understand the different recommendations by authorities for central venous catheter tip position and their basis. 2. Understand potential complications of leaving catheter tips in various upper extremity locations. 3. Understand the changing literature surrounding accurate location of the cavoatrial junction on a chest radiograph and its implications for reporting catheter tip position.

**CONTENT DESCRIPTION:** A tremendous amount of controversy surrounds the appropriate location for central venous catheter tip positioning. The debate centers on placement of the catheter to optimize function while limiting catheter malfunction and patient complications. This poster will explore the differing opinions put forth by various organizations like the Food and Drug Administration, the Society of Cardiovascular and Interventional Radiology, the National Kidney Foundation, and the Infusion Nurses Society and will review literature supporting or refuting each recommendation. Currently, most practitioners would agree that the satisfactory position for the majority of catheter tips (nondialysis) is the cavoatrial junction, as determined on chest radiography. However, the definition of the cavoatrial junction and our ability to accurately identify it on a chest radiograph have changed as well. A portion of this poster will be dedicated to demystifying the varying opinions of the location of the cavoatrial junction on chest radiography with a review of current literature, which includes correlation with multiplanar cross-sectional imaging. This review has implications for the radiologist in determining and suggesting catheter repositioning.

**(E-85) Wednesday • 7:00–8:15 AM**  
**Evaluation of Perianal Fistulas with MR Imaging**

Sandor Szilagyi, MD, *Beth Israel Medical Center, New York, NY*; Angelo Mastropasqua, MD; Alexander C. Kagen, MD (ssandor@chpnet.org)

**LEARNING OBJECTIVES:** 1. Identify the relevant anatomy to evaluate cases of perianal fistula. 2. Identify the MRI findings of perianal fistulas, and properly report and classify these findings. 3. Understand the treatment options available for perianal fistulas.

**CONTENT DESCRIPTION:** In this poster, we will review the anatomy relevant to perianal fistula cases. We will discuss the MRI findings, classification, and reporting of perianal fistula cases. The above points will be demonstrated with a combination of anatomical and MR images with discussion. Additionally, there will be a discussion of the different treatment options.

**(E-86) Thursday • 7:00–8:15 AM**  
**The Nontraumatic Facial Bone Lesion on CT Studies: Pictorial Review of Diagnosis and Management**

Jan C. Mazura, MD, *Cornell Medical College, New York, NY*

**LEARNING OBJECTIVES:** 1. Recognize the typical radiographic (CT) appearance of common facial bone lesions. 2. Understand the etiology, appearance, and management of potentially emergent complications associated with facial bone lesions.

**CONTENT DESCRIPTION:** Nontraumatic facial bone lesions are relatively uncommon and are often found incidentally on computed tomography (CT) studies. With the exception of an infectious process like acute osteomyelitis, these lesions rarely warrant emergent intervention. Nevertheless, a thorough understanding of their radiographic features, typical locations, and potentially emergent complications is essential to performing a complete and comprehensive CT evaluation. CT serves as the primary imaging tool for evaluating facial bone lesions, often providing sufficient information for diagnosis and, perhaps more important, allowing for an assessment of adjacent anatomical structures that may be secondarily compromised by an encroaching lesion. In this educational poster, we present and review common facial bone lesions, including fibrous dysplasia/ossifying fibroma, osteoma, osteomyelitis,

ameloblastoma, dentigerous cyst, and radicular cyst, focusing on their imaging appearance, typical anatomic location, presentation, demographics, and potential complications. Clinical management and follow-up issues are also addressed.

**(E-87) Wednesday • 7:00–8:15 AM**  
**Applications of Advanced Visualization Tools and Web-based Technologies in Medical Student Anatomy Education**

Krishna Juluru, MD, *Weill Medical College of Cornell University, New York, NY*; Donna Magid, MD, MEd (kjuluru@med.cornell.edu)

**LEARNING OBJECTIVES:** 1. Understand some ways in which radiographic data sets can be of educational value to medical students studying anatomy. 2. Review the role of advanced visualization tools and modern file formats in anatomy education. 3. Investigate how Web-based technologies can be used to distribute this teaching material.

**CONTENT DESCRIPTION:** Advanced visualization tools are hardware and software platforms utilized in medical imaging to better understand and interpret large multidimensional data sets. Over the past decade, these tools have seen tremendous development, largely to enhance diagnostic imaging and surgical planning. These data sets have a wealth of information about human anatomy that can also be useful to medical students attempting to understand complex anatomical relationships. In this presentation, we review some ways in which radiographic data sets can be used to supplement anatomy education. We review the role of several commercially available advanced visualization tools and how their primary clinical role can be expanded to the classroom. Finally, we demonstrate how new imaging media can be combined with Web-based technologies for distribution of this teaching material. Tools utilized include TeraRecon, Vital Workstation, and GE Advantage Workstation. The authors identified data sets of anatomically educational value and, using the toolsets, generated customized movies and QTVR files which permit user interaction. For distribution of media, Web-based technologies were preferred due to wide availability and ease of deployment. Movie files were converted to Flash media. A menu-driven interface allows access to movie and QTVR files. The authors provide students with written instruction on anatomical structures to identify in each movie. The volume of information that today's medical student is required to assimilate continues to grow. Technologies that have been utilized for clinical purposes also have a tremendous educational potential. Advanced visualization tools permit an understanding of the human body that is unique from that seen through dissection or portrayed in medical illustration, and these tools can be utilized to supplement medical student anatomy education.

**(E-88) Thursday • 7:00–8:15 AM**  
**Incidental Orbital Findings on Head CT Scans: A Review for the Emergency Radiologist**

Christian S. Geannette, MD, *Weill Medical College of Cornell University, New York, NY*; Kevin W. Mennitt, MD (christiangeanette@yahoo.com)

**LEARNING OBJECTIVES:** Incidental orbital findings on head CT scans are not uncommon. However, radiologists' familiarity with common ophthalmologic pathology, subsequent procedures, and resultant ocular "hardware" implantation seen on imaging is often limited. Becoming comfortable with these findings can significantly impact patient care. This poster will illustrate the pathology, procedures, and postoperative changes through imaging of each, with explanations of the associated radiologic findings. The radiologist will become more knowledgeable about important incidental orbital findings and be able to generate a more thorough, clinically relevant radiologic report after reviewing this poster.

**CONTENT DESCRIPTION:** This poster will present a pictorial review of several common and uncommon ophthalmologic findings. Pathology will include cataracts and detached retinas preoperatively and then postoperatively, with associated postsurgical imaging for each (silicone sclera buckling/banding for retinal detachment, for example). Other imaging will demonstrate lens replacement and prosthetic globes.

\* Faculty financial disclosures are located in the Faculty Index.

**(E-89) Wednesday • 7:00–8:15 AM**  
**Anomalies of the Thoracic Veins**

Mark E. Bittman, MD, *New York, NY*; Navid Rahmani, MD (navrahm@yahoo.com)

**LEARNING OBJECTIVES:** 1. Approach anomalies of the thoracic venous system in an organized fashion. 2. Comprehend the embryogenesis of the thoracic venous system, and understand the consequences of congenital and acquired defects. 3. Understand the application of MR imaging pertaining to these anomalies and how it can complement CT, echocardiography, and conventional angiography.

**CONTENT DESCRIPTION:** Imaging findings will include, but are not limited to, normal thoracic veins; anomalies of the superior vena cava (left SVC and right SVC); anomalies of the inferior vena cava; pulmonary venous anomalies, including total anomalous pulmonary venous return and partial anomalous pulmonary venous return; pulmonary lesions with anomalous venous connections (sequestration, pulmonary AVM, and CCAM). Modalities will include both MR imaging and CT imaging, with an emphasis on current MR techniques.

**(E-90) Thursday • 7:00–8:15 AM**  
**“Confirm IUP”: The Ins and Outs of First Trimester Obstetric US for the Overwhelmed On-Call Resident**

George E. Lynskey III, MD; Ryan B. Viets, MD; Steven C. Portale, MD, *Beth Israel Medical Center, New York, NY*

**LEARNING OBJECTIVES:** 1. Understand the various pathologic conditions associated with the first trimester of pregnancy. 2. Understand the key images needed to exclude entities such as ectopic pregnancy, retained products of conception, and abortion in progress. 3. Identify and understand the images needed to evaluate a normal first trimester gestation at its various stages of development.

**CONTENT DESCRIPTION:** The radiology resident is often requested to evaluate first trimester pregnancy. The request demands a knowledge of both the normal and abnormal findings at a variety of fetal developmental stages. This exhibit will show how to best obtain a normal evaluation of the first trimester fetus and will demonstrate the images needed to confirm or exclude various entities that can complicate early pregnancy.

**(E-91) Wednesday • 7:00–8:15 AM**  
**FDG PET Manifestations of Rare Hematopoietic Malignancies of the Breast**

Daniel T. Ginat, MD, MS, *University of Rochester, Rochester, NY*; Savita Puri, MD

**LEARNING OBJECTIVES:** Hematopoietic malignancies that can be encountered in the breast include lymphomas, leukemia, and plasmacytomas. These are readily imaged via PET/CT and can manifest as unilateral or bilateral, single or multiple, and appear as discrete round/oval masses or diffusely infiltrative. These malignancies can occasionally mimic primary breast cancers. Conversely, benign conditions, such as the lactating breast, can resemble hematopoietic malignancies of the breast. While uncommon, familiarity with hematopoietic malignancies of the breast is important for proper interpretation on FDG PET and for directing patient management.

**CONTENT DESCRIPTION:** In this exhibit, the FDG PET imaging features of patients with hematopoietic malignancies of the breast will be reviewed, including pathology-proven cases of acute myelogenous leukemia, diffuse B-cell lymphoma, acute myeloid leukemia with neutropenic sarcoma, and plasmacytoma. In addition, potential pitfalls will be discussed.

**(E-92) Thursday • 7:00–8:15 AM**  
**Anatomic Variations and Pathologic Processes Involving the Clivus**

Gurpreet S. Dhillon, MD, *University of Rochester, Rochester, NY*; Gunvir Gill, MD; Balasubramanya Kolar, MD; Jeevak Almast (jeevak\_almast@urmc.rochester.edu)

**LEARNING OBJECTIVES:** A number of pathologic processes can affect the clivus, including inflammatory, vascular, and hematopoietic disorders and primary or metastatic tumors. Plain radiography, CT, and MR imaging show and help characterize normal variations in the anatomy of the clivus and help identify pathology. Characteristic imaging findings of several diseases involving the clivus can aid in diagnosis and treatment planning.

**CONTENT DESCRIPTION:** A variety of diseases can involve the clivus and paraclival structures. Inflammatory, vascular, and hematopoietic disorders and primary and metastatic tumors are the most common abnormalities to arise from or directly involve the clivus. Plain radiography, CT, and MR imaging show and help characterize normal variations in the anatomy of the clivus and help identify pathology. Sagittal imaging and coronal imaging allow accurate localization and evaluation of a mass, enabling a more-specific diagnosis. Visualization of the adjacent cranial nerves and vascular structures can aid in surgical planning and radiation therapy. The purpose of this exhibit is to show imaging findings of normal anatomic variations and pathologic processes affecting the clivus.

**(E-93) Wednesday • 7:00–8:15 AM**  
**Carotid Artery Doppler US: Pearls and Pitfalls, with Multimodality Comparative Imaging**

Daniel T. Ginat, MD, MS, *University of Rochester, Rochester, NY*; Ravinder Sidhu; Shweta Bhatt, MBBS; Vikram S. Dogra, MD

**LEARNING OBJECTIVES:** Carotid ultrasound (US) is most commonly performed to evaluate for atherosclerotic disease. However, this modality is also useful for assessing other conditions. The scan is usually performed using high-frequency linear transducers and should include spectral waveform analysis and velocities in the external, internal, and common carotid arteries. In addition, the temporal tap and spectral analysis of the vertebral arteries are routinely performed. Normal and abnormal carotid US findings, with MRI, CTA, and conventional angiography correlation, as well as potential pitfalls, are reviewed.

**CONTENT DESCRIPTION:** Accurately distinguishing between normal variants and disease processes and an awareness of potential pitfalls are essential for guiding proper management and are summarized below.

**Normal Findings:** (a) Reversal of flow is often seen at the bulb. (b) The temporal tap appears as oscillations in the external carotid waveform and implies that the vessel is patent. (c) A dicrotic notch occurs with closure of aortic valve. (d) Stents appear as echogenic mesh structures, while endarterectomy is often imperceptible, manifesting as slight wall irregularity.

**Abnormal Findings:** (a) Atherosclerotic disease is common and ranges from intimal hyperplasia to occlusion. (b) The string sign is characteristic of nearly occlusive disease. (c) External carotid occlusion results in internalization of the common carotid. (d) Pulsus bisferiens occurs with aortic insufficiency, and pulsus alternans occurs with heart failure. (e) Subclavian steal affects the vertebral waveforms and is described in four stages of severity. (f) Uncommon disorders such as dissection, carotid-jugular fistula, and fibromuscular dysplasia are readily evaluated with US.

**Pitfalls:** (a) Arrhythmias and presence of cardiac assist devices can compromise the validity of the study. (b) Tandem lesions result in underestimation of the velocities in the distal lesions. (c) Contralateral internal carotid occlusion leads to velocity elevation. (d) Tortuous vessels may cause velocity overestimation. (e) Bradycardia results in low diastolic velocities. (f) Collateral vessels may be misinterpreted as patency in the setting of occlusion.

**(E-94) Thursday • 7:00–8:15 AM**  
**Spinal Ossification Revisited: Osteophyte, Syndesmophyte, Paravertebral Ossification, and Flowing Hyperostosis**

Gurpreet S. Dhillon, MD, *University of Rochester, Rochester, NY*; Gwy Suk Seo, MD, PhD; Gregory Dieudonne, MD; Johnny U. Monu, MD (gwysuk\_seo@urmc.rochester.edu)

**LEARNING OBJECTIVES:** 1. Recognize different types of spinal or paraspinal ossification (osteophyte, syndesmophyte, paravertebral ossification, and flowing hyperostosis). 2. Know the clinical settings where each of these ossifications can be seen. 3. Understand the limitations and pitfalls of this approach.

**CONTENT DESCRIPTION:** Spinal ossification is a commonly identified abnormality in radiologic imaging. It is important to recognize the different types of spinal or paraspinal ossification, which include osteophytes, syndesmophytes, paravertebral ossification, and flowing hyperostosis. Each of these categories has a characteristic imaging appearance and occurs in a distinctive clinical background. In this exhibit, we present several examples of each entity to allow clear distinction from the others. We also review the clinical significance and complications of each abnormality.

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**(E-95) Wednesday • 7:00–8:15 AM**  
**Fractures of the Fifth Metatarsal: What Is in a Name?**

Parul Patel, MD, *University of Rochester, Rochester, NY*; Malin Cesarz, MD; Gwy Suk Seo, MD, PhD; Johnny U. Monu, MD (parul\_patel@urmc.rochester.edu)

**LEARNING OBJECTIVES:** Many fractures in the proximal fifth metatarsal are often erroneously called Jones fractures. This exhibit aims to (1) differentiate the more common types of fractures at the proximal fifth metatarsal from the Jones fracture, (2) review the various prognostic factors associated with these fractures, and (3) discuss the available treatment options.

**CONTENT DESCRIPTION:** A historical background is provided to define the Jones fracture. A Jones fracture is a well-defined acute fracture occurring at the junction between the proximal metaphysis and diaphysis of the fifth metatarsal and associated with a higher risk of nonunion. Relevant anatomy of the articulations around the fifth metatarsal, including muscle and ligament attachments, is reviewed to facilitate understanding of the mechanism of injury, the prognostic factors, and the basis of the treatment. By using images from our imaging database, the various injury patterns and classification options are illustrated. The various management options for these injuries are also discussed.

**(E-96) Thursday • 7:00–8:15 AM**  
**Multimodality Imaging of the Aorta before, during, and after Repair**

Daniel T. Ginat, MD, MS, *University of Rochester, Rochester, NY*; Shweta Bhatt, MBBS; Michael Singh; Vikram S. Dogra, MD

**LEARNING OBJECTIVES:** Indications for aortic repair include aneurysm, dissection, severe coarctation, rupture, and critical stenosis. The main types of repair include the traditional open surgeries, the less-invasive endovascular approaches, and combinations of both (hybrid techniques). Imaging plays a key role in determining whether intervention is indeed necessary, in selecting the most appropriate technique, and in postrepair monitoring. Radiologists should be familiar with the corresponding postoperative imaging appearances with various modalities in order to appropriately diagnose potential complications. Multimodality imaging features of thoracic and abdominal aorta diseases and their treatments will be illustrated. In particular, distinguishing between normal and abnormal postintervention appearances will be emphasized.

**CONTENT DESCRIPTION:** Selected cases pertaining to the following issues will be illustrated:

*Indications:* Thoracic and abdominal aorta aneurysm/pseudoaneurysm, dissection, rupture, coarctation, and midaortic syndrome.

*Procedures:* Open thoracic (Cabrol, elephant trunk, and Bentall), open abdominal, hybrid, thoracic endovascular, and abdominal endovascular repairs.

*Normal Postrepair Appearance:* Radiodense felt pledgets and sutures, which can mimic leaks. Perigraft fluid up to 3 months, perigraft air up to 4–7 weeks, endograft coverage of the subclavian and inferior mesenteric arteries, residual intramural thrombus and aneurysm sac surrounding endografts, and residual low-grade activity on PET.

*Complications:* Infection, pseudoaneurysm, rupture, aortoenteric fistula, endoleaks, and stent-graft kinking and migration, among others.

**(E-97) Wednesday • 7:00–8:15 AM**  
**Imaging Features of Cardiac Assist Devices**

Daniel T. Ginat, MD, MS, *University of Rochester, Rochester, NY*; Shweta Bhatt, MBBS; Todd Massey; Vikram S. Dogra, MD

**LEARNING OBJECTIVES:** With the increasing duration of circulatory support, diagnostic imaging plays an important role in the management of patients on a ventricular assist device. Therefore, radiologists must be familiar with basic components of these devices and their radiographic appearances in order to appropriately diagnose complications related to their use. The goals of this educational exhibit include the following: (a) review the types and components of various commercially available ventricular assist devices, and correlate with CT and x-ray, (b) illustrate the normal imaging appearances of ventricular assist devices, and (c) demonstrate possible complications.

**CONTENT DESCRIPTION:** The normal and abnormal CT and x-ray appearances will be depicted for the following devices: (1) surgically implanted ventricular assist devices: (a) left ventricular assist device, (b) right ventricular assist device, and (c) bilateral ventricular assist device; (2) percutaneous ventricular assist device; and (3) intraaortic balloon pump.

**(E-98) Thursday • 7:00–8:15 AM**  
**Current and Future Applications for Diffusion-weighted MR Imaging for Prostate Cancer**

Bhavya Rehani, MD, *University of Cincinnati, Cincinnati, OH*; Sadhna Verma, MD

**LEARNING OBJECTIVES:** 1. Outline the technique of diffusion-weighted imaging (DWI), and understand different protocols using 1.5 and 3 T that can be utilized for DWI. 2. Review the spectrum of radiologic findings of prostate cancer on DWI and the ways to develop skills to identify, characterize, and stage prostate cancer. 3. Highlight the current research, limitations, and future directions of DWI.

**CONTENT DESCRIPTION:** I. DWI technique: protocols using 1.5 and 3 T; briefly discuss diffusion sensitizing factor (*b* value) and apparent diffusion coefficient (ADC), with tips to optimize the sequence and pitfalls. II. Imaging findings for prostate cancer. A. Detection and distinction from normal prostate. B. Characterization based on qualitative and quantitative values. C. Staging. D. Prognostication. III. Utilizing diffusion-weighted imaging (DWI) as a targeted biopsy tool. IV. Current research, future directions, and possibilities of utilizing diffusion-tensor imaging (DTI).

**(E-99) Wednesday • 7:00–8:15 AM**  
**Radiopathologic Details of Gastrointestinal Stromal Tumors: An Educational Approach**

Charles R. Wehbe, MD, *University Hospitals Case Medical Center, Cleveland, OH*; Baz Debaz, MD; Fadi Abdelkarim, MD (charles.wehbe@uhhospitals.org)

**LEARNING OBJECTIVES:** The purpose of this study is to provide a concise and complete overview of the radiological and pathological diagnostic features of gastrointestinal stromal tumors (GISTs). These findings will be correlated with micropathological findings and clinical prognostic outcomes. A concise overview, which is case based, will bring together and describe the pathological findings and correlate them with the radiological findings on CT, MRI, and ultrasound. Through this presentation, the reader should be able to describe the radiological findings of GISTs secondary to the pathological features. This radiopathological correlate will concretize and make further sense of the radiological appearance, which will eventually help narrow the radiological differential diagnosis.

**CONTENT DESCRIPTION:** Thirty-two radiological studies of patients with a GIST diagnosis proven with pathology were analyzed. The detailed radiological manifestations were correlated with the micropathological findings to better understand and explain the radiological appearance with CT, MRI, and ultrasound. These manifestations were then correlated with the clinical presentation and eventually with the clinical outcomes of the patients. These findings were then compiled to present the reader with an overview of the radiopathological findings and correlations of GISTs.

**(E-100) Thursday • 7:00–8:15 AM**  
**Vascular Malformations in the Brain and Spine at a Glance: A Pictorial Essay**

Shaun J. Gonda, MD, *Oregon Health Sciences University, Portland, OR*; Vaishali Phalke, MD (shaungonda@gmail.com)

**LEARNING OBJECTIVES:** 1. Recognize common vascular malformations in the brain and spine, including developmental venous anomalies, cavernous malformations, vein of Galen aneurysms, capillary telangiectasias, arteriovenous malformations, and dural arteriovenous fistulas. 2. Identify distinguishing imaging features of these abnormalities using various imaging modalities, including MRI, CT/CTA, and diagnostic angiography. 3. Recognize associated abnormalities commonly seen with certain vascular malformations. 4. Briefly discuss which lesions require intervention and which can be left alone. 5. Use common imaging features of these abnormalities to distinguish them from other possible abnormalities in the brain and spine, such as tumor, infection, or infarction.

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**CONTENT DESCRIPTION:** I. Provide examples of typical imaging findings of and associations with common vascular malformations in the brain and spine by using a variety of imaging modalities, including MRI, CT/CTA, and cerebral angiography. II. Briefly discuss which abnormalities require intervention and which can be left alone. III. Discuss important distinguishing features of these abnormalities to ensure that these are not mistaken for other common pathology in the brain and spine, including tumor, infection, and infarction.

**(E-101) Wednesday • 7:00–8:15 AM**  
**Alveolar Soft Part Sarcoma: Review of Clinical, Pathologic, and Radiologic Findings**

Mark A. Mingos, MD, *University of Pennsylvania Health System, Philadelphia, PA*; Phillip Koo, MD; Gary Greene, MD (mark.mingos@uphs.upenn.edu)

**LEARNING OBJECTIVES:** 1. Become familiar with alveolar soft part sarcoma (ASPS), a rare subclassification of soft-tissue sarcoma. 2. Understand the clinical, pathologic, and radiologic characteristics of ASPS, with particular attention to radiologic-pathologic correlation. 3. Identify key imaging features of ASPS, and apply them practically in differential diagnoses.

**CONTENT DESCRIPTION:** Alveolar soft part sarcoma (ASPS) is a rare malignancy, encompassing less than 1% of soft-tissue sarcomas. It is encountered most commonly in younger patients, particularly those in the 1st to 3rd decades of life, and is slightly more prevalent in women. Anatomically, the tumor is most likely to occur in the buttock or lower extremity, followed less commonly by the upper extremity and head and neck region. Clinical characteristics are highly dependent on anatomic location, with those tumors in the extremities usually presenting either due to mass effect or symptoms referable to early metastases. Alternatively, with tumors involving the head and neck region, patients may present with difficulty breathing or swallowing. As this is a very vascular tumor, the mass may be pulsatile on physical examination and may also exhibit an audible bruit on auscultation. ASPS is so named because of its histologic appearance, which features large granular cells arranged in nests, resembling respiratory alveoli, separated by an extensive vascular network. On gross examination, there is consistent evidence of extensive vascularity and, not uncommonly, encapsulation and variable central necrosis. At CT imaging, these tumors are hypodense relative to muscle prior to the administration of intravenous contrast, with avid homogeneous enhancement following contrast administration. MR features are highly characteristic and include well-circumscribed lesions which show slight T1 hyperintensity, strong T2 hyperintensity, avid contrast enhancement, and numerous signal flow voids. Combined PET/CT imaging typically demonstrates hypermetabolic activity of both primary and metastatic lesions and is advantageous compared to anatomic imaging alone in detecting metastatic disease.

**(E-102) Thursday • 7:00–8:15 AM**  
**Pediatric Emphasis Diagnostic Radiology Alternative Pathway (PEDRAP): Our Preliminary Experience**

Ami Modh, DO, *Hahnemann University Hospital, Philadelphia, PA*; Mollie McGinley, BS, MD; Nachum B. Stollman, MD; Robert A. Koenigsberg, DO; Eleanor M. Smergel, MD (eleanor.smergel@tenethealth.com)

**LEARNING OBJECTIVES:** 1. Discuss the goals of the PEDRAP initiative as it relates to radiology education. 2. Describe the design of the PEDRAP curriculum. 3. Define the successes and limitations of the program during our initial experience.

**CONTENT DESCRIPTION:** The Pediatric Emphasis Diagnostic Radiology Alternative Pathway (PEDRAP) was implemented by the American Board of Radiology in response to the nationwide shortage of pediatric radiologists. Our program enrolled in this pilot pathway shortly after its adoption in 2005. We report our experience to date with this unique curriculum.

*Design:* There are currently two 4th-year radiology residents and one 2nd-year radiology resident participating in the PEDRAP initiative in our Philadelphia training program. A fourth candidate is currently completing his transitional year and is anticipated to join the program in July 2010. All

candidates complete 28 four-week rotations at the parent institution (Hahnemann University Hospital) and 24 four-week rotations at the affiliated children's hospital (St. Christopher's Hospital for Children). Requirements of traditional radiology residencies (including instructional time at the Armed Forces Institute of Pathology and mammography/nuclear medicine requirements) are upheld.

*Conclusion:* As the American Board of Radiology redesigns the structure and timeline for board certification with an emphasis on subspecialty training, this alternative pathway parallels the new approach to radiology education as a whole. Specifically, it allows radiology residents with an affinity toward pediatrics to effectively experience subspecialty training in pediatric radiology during residency years, along with the autonomy and responsibility inherent in that design. Not only does this program spark an interest in pediatric radiology among participants, but it also addresses a shortage of pediatric radiologists. This exhibit addresses the design of this program at our institution, its attributes and shortcomings, and its future direction.

**(E-103) Wednesday • 7:00–8:15 AM**  
**Traumatic Fractures of the Sacrum and Sacroiliac Joint: A Review for Residents**

Ryan Berecky, MD, *University of Texas Southwestern Medical Center, Dallas, TX*; Benjamin Garvey, MD; Richard Suss, MD; David P. Chason, MD (david.chason@utsouthwestern.edu)

**LEARNING OBJECTIVES:** 1. Review the anatomy of the sacrum and the sacroiliac joint. 2. Outline common classification systems for sacral and sacroiliac injuries and their associated mechanisms. 3. Understand the clinical implications of these injuries.

**CONTENT DESCRIPTION:** Fractures of the pelvis are common in the trauma setting, and among them, injuries of the sacrum and sacroiliac joint are often subtle. They also may be associated with neurological injury. Despite advances in CT and MR imaging, injuries of the sacrum and sacroiliac joint are too often identified late in the clinical course, leading to increased morbidity and mortality. Radiology residents must be alert to such injuries and classify them according to their clinical relevance. This exhibit describes and illustrates sacral and sacroiliac joint anatomy on x-ray film and CT and discusses the morphology and clinical implications of their injuries.

**(E-104) Thursday • 7:00–8:15 AM**  
**Radiographic Manifestation of Laparoscopic Cholecystectomy Complications**

Sabina Amin, BS, MD, *Dallas, TX*; Ethan O. Cohen, MD; Julie G. Champine, MD; Edward Chen

**LEARNING OBJECTIVES:** 1. Understand the differential diagnoses for the postcholecystectomy fluid collection. 2. Recognize the imaging appearance of other common postcholecystectomy complications. 3. Understand the utility of different imaging modalities in the postcholecystectomy patient with persistent pain. 4. Appreciate the etiology and mechanism behind each complication.

**CONTENT DESCRIPTION:** Over the last 2 decades, laparoscopic cholecystectomy has replaced open cholecystectomy as the standard of care for gallbladder surgery. An entire set of new complications has arisen with this change, and it is important for the radiology resident to understand their imaging appearance. The purpose of this exhibit is to educate residents about the multiple potential complications of laparoscopic cholecystectomy.

**(E-105) Wednesday • 7:00–8:15 AM**  
**Practical Applications of Diffusion-Tensor Imaging in Conjunction with Conventional MR Imaging**

Shilpa Pandey, MD, *Texas Tech University Health Sciences Center, El Paso, TX*; Jose Gavito, MD (shilpa.pandey@ttuhsc.edu)

**LEARNING OBJECTIVES:** 1. Understand how diffusion-tensor imaging (DTI) can be a complementary MRI tool in neuroimaging by providing information about the amount and directionality of diffusion in white matter. 2. Understand the methodology and findings in the most frequently used applications of DTI, such as brain tumors, multiple sclerosis (MS), and diffuse

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axonal injury (DAI). 3. Understand implementation of these techniques in a radiology practice and potential limitations.

**CONTENT DESCRIPTION:** *Background:* Diffusion-tensor imaging (DTI) is a powerful new tool which allows measurement of the amount and directionality of water diffusion. Certain tissues, such as white matter, have anisotropy (directionality), which can be analyzed through DTI. Characteristics of white matter such as fractional anisotropy, which measures the amount of directionality a tissue contains, and tractography, which allows mapping of white matter tracts, can be assessed.

*Multiple Sclerosis:* Diffusion-tensor imaging has shown low fractional anisotropic values for active MS lesions. Where conventional MRI techniques show normal-appearing white matter, DTI can detect earlier damage in the subcortical white matter and identify relapsing-remitting injury to the corpus callosum.

*Brain Tumors:* Conventional MRI underestimates the extent of brain tumors, and DTI may be better able to delineate edema, tumor, and normal brain tissue. The primary use of DTI is through tractography, in determining which white matter tracts are affected by brain tumors.

*Diffuse Axonal Injury:* CT and conventional MRI underestimate DAI. DTI allows quantification of the extent of injury through fractional anisotropy (FA). Patients with DAI are shown to have low FA values acutely, with some recovery 9–15 months after injury.

*Conclusion:* DTI is a useful adjunct to conventional MRI in the definition of brain tumors, MS, and trauma. However, more studies need to be performed with a larger number of patients. Additionally, more longitudinal studies need to be conducted to assess the viability of DTI.

### **(E-106) Thursday • 7:00–8:15 AM Advantage of Multiplanar Reconstruction in the CT Diagnosis of Intestinal Obstruction or Spontaneous Abdominal Hemorrhage**

Jesus R. Diaz, MD; Bharat Kakarala; Jesus E. Calleros Macias, MD, *Texas Tech University Health Sciences Center, El Paso, TX* (jesus.calleros@ttuhsc.edu)

**LEARNING OBJECTIVES:** 1. Recognize findings associated with intestinal obstruction or hemoperitoneum. 2. Recognize CT with multiplanar reformations (CT-MPR) as a useful adjunct tool in acute abdominal emergencies.

**CONTENT DESCRIPTION:** Intestinal obstruction may be caused by a myriad of processes. Recognition of associated findings is of paramount importance in optimization of quick decision making. Computed tomography with multiplanar reconstructions (CT-MPR) can help define a transition point as a solitary finding or associated with wall thickening, wall attenuation, and preserved folds. If an intraluminal mass is present, is this mass adherent to the wall, is there air within the mass, or is the distal bowel decompressed? Signs of extraluminal extension can be found within adjacent mesenteric vessels, fat, or lymph nodes. Pneumobilia and the characteristics of adjacent viscera are findings that can be recognized with CT-MPR. Five patients are presented with unique CT-MPR findings of clinical bowel obstruction. Spontaneous hemoperitoneum is infrequent. Often, bleeding masses and platelets or coagulation disorders are the etiology. CT-MPR can readily recognize irregular low-attenuation defects in organs and blood-attenuation fluid collections, with or without adjacent higher attenuation, and can localize these abnormalities to the omentum, mesentery, or retroperitoneum. Isodense areas adjacent to opacified vessels, organomegaly, and solid masses are findings that can be recognized with CT-MPR. Six patients are presented with sudden-onset abdominal pain, decreased Hb/Hct, and/or hypotension with the preoperative diagnosis apparent by CT-MPR. CT-MPR is essential for the rapid demonstration of pertinent associated findings of intestinal obstruction or decreased Hb/Hct and/or hypotension.

### **(E-107) Wednesday • 7:00–8:15 AM Transvenous Embolization of a Left Sigmoid Sinus Dural Fistula via Retrograde Catheterization of Ophthalmic Vein, Sigmoid Sinus, and Inferior Petrosal Sinus**

Rajesh Rangaswamy, MD, *Scott and White Memorial Hospital/Texas A&M Health Sciences Center, Temple, TX*; Jennifer Hester, MD; Walter S. Lesley, BS, MD; Delip V. Patel, MD, MBA

**LEARNING OBJECTIVES:** 1. Understand the different types of dural AV fistulas. 2. Understand the management of intracranial dural AV fistulas.

3. Describe the retrograde catheterization and embolization of the sigmoid sinus through the inferior petrosal sinus.

**CONTENT DESCRIPTION:** *Introduction:* Arteriovenous fistulas (AVFs) account for 10%–15% of all intracranial arterial vascular malformations (AVMs). Endovascular surgical management of dural AVF has become more widely considered a primary therapeutic modality for most dural AVFs. We report the first transvenous embolization of a sigmoid sinus fistula via left ophthalmic venous access.

*Case Report:* A 50-year-old man presented to the neurointerventional clinic with progressive symptoms of left diplopia and proptosis secondary to type 3 sigmoid sinus dural AVF. The subsequent angiogram demonstrated a dural AVF of the left sigmoid sinus, with retrograde flow through the inferior petrosal sinus, cavernous sinus, and left superior ophthalmic vein. There was also some antegrade flow through the internal jugular vein, which appeared severely stenosed. This was transvenously embolized via retrograde ophthalmic vein, cavernous sinus, inferior petrosal catheterization, and sigmoid sinus catheterization.

*Discussion:* I. Types of dural AVF. II. Symptoms. III. Endovascular treatment options for dural AVF.

### **(E-108) Thursday • 7:00–8:15 AM Musculoskeletal MR Imaging: A Primer Illustrating Classic Cases and Diagnostic Conundrums**

John N. Morelli, MD, *Scott and White Memorial Hospital/Texas A&M Health Sciences Center, Temple, TX*; Val M. Runge, MD\*; Vasant Garg; Shivang Desai; David M. Watkins, MD; Fei Ai, MD (dr.john.morelli@gmail.com)

**LEARNING OBJECTIVES:** 1. Recognize the appearance of the most common pathologies affecting the musculoskeletal system on MR images. 2. Understand diagnostic dilemmas in MR imaging of the musculoskeletal system, and utilize this knowledge to produce accurate differential diagnoses for a given imaging finding. 3. Appreciate basic technical issues related to pulse sequence and protocol selection in MRI of the musculoskeletal system, and apply these to optimize the diagnostic quality of images in everyday clinical practice.

**CONTENT DESCRIPTION:** A resident's initial foray into a musculoskeletal MRI rotation can be intimidating. We have created internally at our institution, by conducting a search of all case imaging performed within the last 5 years, an atlas to help ease this transition by illustrating the most classic appearance of the major pathologies from each portion of the musculoskeletal system with state-of-the-art high-field MRI (both 1.5 and 3 T). Parts of this atlas will be presented in this exhibit. Major topics to be covered include pathologies of the knee, shoulder, hip, wrist, elbow, temporomandibular joint, ankle, and foot. In the knee, for example, relevant discussion and images demonstrating the various morphologies of meniscal tears, anterior and posterior cruciate ligament injuries, lateral and medial collateral ligament tears, and osteochondral lesions are included. Subsequent discussion focuses on a description of the classic MR appearances of each lesion, providing additional background information in the context of MR physics when appropriate. Diagnostic dilemmas in the interpretation of potentially confusing or misleading findings are emphasized, with a focus on the development of accurate differential diagnoses for such findings. Technical issues related to pulse sequence and protocol selection are described in the general context of optimizing the diagnostic quality of an MR imaging study. After viewing this poster, residents and physicians in practice who are less experienced with MR imaging will emerge with an improved overall knowledge of MR imaging of the musculoskeletal system.

### **(E-109) Wednesday • 7:00–8:15 AM CT-guided Lung Nodule Biopsy: A Primer on Performance and Risk Reduction**

Kathy M. Borovicka, MD, BS, *William Beaumont Hospital, Royal Oak, MI*; Kiran R. Nandalur, MD (nandalurk@yahoo.com)

**LEARNING OBJECTIVES:** 1. Review the technique of CT-guided lung nodule biopsy utilized at our university. 2. Describe ways of minimizing the risk of complications and maximizing diagnostic efficacy. 3. Discuss management of complications such as pneumothorax and hemorrhage.

**CONTENT DESCRIPTION:** We will show and discuss the approach utilized for performing a CT-guided lung biopsy at our institution by

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reviewing 10 examples of pertinent cases with a quiz answer format. Specific topics/cases include (a) planning the procedure, including core- versus fine-needle aspiration; (b) step-by-step performance, including choice of needles; (c) methods of minimizing risk of pneumothorax, such as the blood patch and patient positioning; and (d) managing complications and common questions. CT-guided lung nodule biopsy is integral in the diagnosis of lung infectious, inflammatory, and neoplastic conditions. Proper technique can lead to better pathological specimens, reduced patient discomfort, and fewer complications. Knowledge of the basics of CT-guided lung nodule biopsy and less-utilized techniques such as the blood patch is important for radiologists.

**(E-110) Thursday • 7:00–8:15 AM**  
**Right Lower Quadrant Pain: Is It Really Just Appendicitis? Review of Imaging Findings of Acute Appendicitis and Unusual Mimics**

Kyungmin Shin, MD, *University of Virginia, Charlottesville, VA*; Drew Lambert, MD

**LEARNING OBJECTIVES:** 1. Review the appearance, anatomy, and positioning of the normal appendix. 2. Review different modalities, including ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI), used for evaluation/diagnosis of acute appendicitis in different age groups and populations. 3. Case reviews of typical imaging appearance of pathology-proven acute appendicitis, including tip appendicitis, gangrenous/perforated appendicitis, and appendicitis with periappendiceal abscess. 4. Case reviews of uncommon pathology presenting as acute appendicitis, such as carcinoid tumor, appendiceal mucocele, cecal mass, and myxoid degeneration.

**CONTENT DESCRIPTION:** “Rule out appendicitis” and “right lower quadrant pain” are some of the most common ER indications for CT of the abdomen and pelvis. However, sometimes the appendix can be difficult to evaluate secondary to its variability in position, normal anatomic variability in size, and the concern for exposure to ionizing radiation in children and in women of childbearing age. Over 100 cases of acute appendicitis using CT, US, and MRI performed over a 1-year period in our institution were reviewed. Suspected imaging findings of appendicitis were correlated with surgical pathology to confirm the diagnosis of acute appendicitis. Additionally, several unusual diagnoses presenting as acute appendicitis were found at final surgical pathology, including carcinoid tumor, appendiceal mucocele, cecal lymphoid hyperplasia, myxoid degeneration, distal fibrous obliteration, and eosinophilic appendicitis. This exhibit will review not only the typical imaging appearance of acute appendicitis but also these unusual mimics.

**(E-111) Wednesday • 7:00–8:15 AM**  
**Radiologic Manifestations of Chronic Recurrent Multifocal Osteomyelitis**

Ramesh S. Iyer, MD, *University of Washington, Seattle, WA*; Mahesh M. Thapa, MD (thapamd@uw.edu)

**LEARNING OBJECTIVES:** 1. List common radiographic, CT, MRI, and nuclear medicine findings of chronic recurrent multifocal osteomyelitis (CRMO). 2. Identify the classic clinical and laboratory findings of CRMO. 3. Discuss the differential diagnosis for CRMO.

**CONTENT DESCRIPTION:** I. Definition of CRMO. II. Clinical and laboratory findings of CRMO. III. Radiologic (including plain film, CT, MR, and nuclear medicine) findings in CRMO. IV. Multiple images of CRMO affecting various body parts.

**(E-112) Thursday • 7:00–8:15 AM**  
**Musculoskeletal Manifestations of Neurofibromatosis**

Stephen E. Darling, MD, *University of Washington, Seattle, WA*; Felix S. Chew, MD, MBA; Shawn E. Parnell, MD (sdarling@u.washington.edu)

**LEARNING OBJECTIVES:** 1. Recognize the imaging manifestations of neurofibromatosis type 1 in the musculoskeletal system. 2. Discuss the contribution of musculoskeletal findings to the diagnosis of neurofibromatosis type 1. 3. Describe common musculoskeletal complications of neurofibromatosis type 1.

**CONTENT DESCRIPTION:** Although there have been significant advances in the molecular genetics of neurofibromatosis type 1 (von

Recklinghausen’s disease), one of the most common single-gene heritable disorders, the diagnosis still rests on specific clinical features. Distinctive osseous lesions constitute one of seven criteria for the positive diagnosis. As many as half of the patients with neurofibromatosis type 1 have significant musculoskeletal manifestations, including neurofibromas, dystrophic scoliosis, congenital pseudarthrosis, vertebral scalloping, sphenoid dysplasia, intraosseous lesions, ribbon rib deformities, and cortical thinning of long bones. The appropriate use of radiography, computed tomography, and magnetic resonance imaging will contribute to diagnosis and management. For patients with musculoskeletal involvement, early recognition and treatment may ameliorate complications.

**(E-113) Wednesday • 7:00–8:15 AM**  
**Be Hip to the Hip: Imaging of Acetabular Fractures**

Matthew H. Nett, *University of Washington, Seattle, WA*; Robert Carr; Felix S. Chew, MD, MBA; Michael L. Richardson, MD; Robert O. Nathan, MD

**LEARNING OBJECTIVES:** 1. Discuss the normal imaging anatomy of the acetabulum. 2. Recognize and accurately classify various types of acetabular fractures.

**CONTENT DESCRIPTION:** Acetabular fractures are severe injuries commonly encountered in the setting of blunt trauma, and accurate diagnosis and description are important skills for radiologists. Acetabular fractures can be difficult to characterize on two-dimensional radiographs and CTs because of the complex three-dimensional anatomy of the pelvis and acetabulum. Understanding the various types of fractures and their classification, however, is important for proper surgical planning and treatment. This presentation will provide a case-based summary of acetabular fractures and the most commonly used classification schemes, with a special emphasis on 3D reformations.

**(E-114) Thursday • 7:00–8:15 AM**  
**Tumorama: An Interactive Web-based Database-backed Atlas of Musculoskeletal Tumors**

Michael L. Richardson, MD, *University of Washington, Seattle, WA*; Jonelle Petscavage, MD; Leila Khorashadi, MD; Kiley D. Perrich, MD; Vipul Sharma, MD; Christin M. Brown, MD; et al (mrich@uw.edu)

**LEARNING OBJECTIVES:** After reading this exhibit and using the Web site it describes, the learner will be able to: 1. Interactively compare the images from multiple tumors that share the same histologic type. 2. Interactively filter the cases in this atlas by multiple parameters, such as matrix type, specific bone, location (cortex vs medulla), location (central vs eccentric), location (axial vs appendicular), location (in relation to the physis), periosteal reaction, and extrinsic soft-tissue mass.

**CONTENT DESCRIPTION:** This poster describes an interactive Web-based database-backed atlas of musculoskeletal tumors. The database back end allows the user to interactively view the cases in this atlas sorted and filtered by multiple variables, including histologic type, matrix type, specific bone, location (cortex vs medulla), location (central vs eccentric), location (axial vs appendicular), location (in relation to the physis), periosteal reaction, and presence of extrinsic soft-tissue mass. Unlike a standard tumor text with just a few cases of each diagnosis, this Web-based atlas allows one to view many tumors of the same histologic type side by side. Unlike a static Web site, the database back end of this atlas creates new pages on the fly, which update instantly as new cases are added. This Web-based atlas is built with open-source software, including Apache, MySQL, SQLite, and PHP.

**(E-115) Wednesday • 7:00–8:15 AM**  
**Small Bowel Perforation: Differential Diagnosis and Spectrum of CT Findings**

Dameon R. Duncan, MD, MBA, *Long Island Jewish Medical Center, New Hyde Park, NY*; Juliana Rosenblat, BA; Anoop S. Wattamwar, MD; John Hines, MD; Douglas S. Katz, MD; Barak Friedman, MD (jhines@lij.edu)

**LEARNING OBJECTIVES:** Small bowel perforation is an infrequently encountered entity during abdominal imaging. The goal of this exhibit is to exemplify, using CT examples, the various pathological

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states which ultimately result in small bowel perforation. At the conclusion of this presentation, the participant should be able to: 1. Provide a comprehensive differential diagnosis for small bowel perforation. 2. Identify the CT findings associated with small bowel perforation. 3. Be familiar with the radiology and clinical literature on small bowel perforation.

**CONTENT DESCRIPTION:** A series of cases with short histories will be presented, with emphasis on the CT findings. Following each case, the diagnosis and differential will be discussed, as well as the specific features of the entity being demonstrated. CT combined with history can often define the site and etiology of small bowel perforation. CT examples of the following causes of small bowel perforation will be demonstrated: anastomotic leak; Crohn disease; small bowel diverticulitis; foreign bodies; iatrogenic etiologies; ischemia from primary and secondary etiologies (ie, obstruction); malignancy, of both primary and metastatic etiologies; and blunt and penetrating trauma. The relevant imaging and clinical literature for each entity will also be briefly reviewed.

**(E-116) Thursday • 7:00–8:15 AM**  
**Anatomy Education: Cost Comparison of Cadavers and Computers**

Andrew Phelps, *University of California, San Francisco, San Francisco, CA*; Richard S. Breiman, MD

**LEARNING OBJECTIVES:** 1. Understand the logistics and cost of cadaver acquisition and disposal. 2. Recognize that computer costs will continue to decline with time, whereas cadaver costs will not.

**CONTENT DESCRIPTION:** *Background:* Anatomy education is historically rooted in cadaveric dissection. With improved technology and affordability, more computers are being used to teach anatomy. However, studies attempting to validate computer-based anatomy education have yielded conflicting results. Our study evaluates the issue from a different angle: What are the logistical and cost differences between cadavers and computers?

*Method and Materials:* Information was gathered from (a) University of California, San Francisco (UCSF) Willed Body Program, (b) UCSF Henry Goldberg Computer Learning Center, and (c) *newegg.com*.

*Results:* The average cost of a cadaver at UCSF is \$2600; this only accounts for the dedicated staff who handle acquisition and disposal. In comparison, a computer suitable for running current three-dimensional rendering software costs \$1400, and it can be reused for several years. Given these differences, and depending on class size, the cost of many computers for a dissection lab could be offset by a small reduction in cadaver usage.

*Conclusion:* The increasing affordability of computers may challenge the historical role of cadavers in anatomy education, but further research validating computer usage is needed.

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