AUR 2012 Research Paper Abstracts

Research papers are oral educational or scientific presentations that 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, fellows, or 1st-year fellows) are noted in burnt orange.

Wednesday, March 21, 2012
2:00–3:30 PM

SS01: Scientific Session 1
Education I
Location: Grand Oaks Ballroom L, P, and Q

Moderators: Janet E. Bailey, MD
Sandra J. Allison, MD

`ED` `MA`

(SS01-01) 2:00 PM
Quantitative Metric to Evaluate the Clinical Significance of Changes Made to Trainee Radiology Reports

Arthur Baghdanian, BS, *Thomas Jefferson University, Philadelphia, PA*; Richard E. Sharpe, Jr, MD, MBA; Richard J. Gorniak, MD★; Levon N. Nazarian, MD; Vijay A. Rao, MD; Adam Flanders, MD★ *(arthurbag@gmail.com)*

PURPOSE: The purpose was to investigate whether the quantity of edits made to trainee preliminary radiology reports is related to the clinical significance of these revisions.

METHOD AND MATERIALS: This IRB-approved project extracted every 10th pair of consecutive radiology preliminary and finalized reports from December 30, 2010, to February 19, 2011, for analysis. Open-source software was used to determine the Levenshtein distance (LD), the number of character changes required to convert each preliminary report impression to its corresponding finalized impression. The LD was divided by the total number of characters in the impression to calculate the Levenshtein percent (LP), a value that corrects for differences in impression lengths among reports. Each of these impression pairs was manually reviewed by two authors using an a priori determined rubric scoring the increasing clinical significance of report changes. The LP and clinical significance scores were evaluated with a Pearson correlation using an α of 0.05.

RESULTS: A total of 424 examinations met criteria for inclusion in the study. The average impression LP was 10.44% (95% CI, 8.48–12.40), indicating that on average, 10.44% of the characters in a preliminary impression will be changed by each attending radiologist. Regarding the manual analysis of the clinical significance of changes, the largest number of report impressions, 329 (77.6%), contained no changes. Thirty (7.1%) of the studies contained stylistic changes only, 43 (10.1%) provided additional detail in the finalized impression without additional findings, 10 (2.4%) of the finalized impressions described new findings that were not clinically significant, two (0.5%) of the finalized reports added findings related to chronic conditions, and 10 (2.4%) of the report impressions contained changes that could affect acute patient management. The Pearson correlation for each LP and the clinical significance ratings described above is +0.75, with a significance of $P < .001$.

CONCLUSION: This study establishes the Levenshtein percent as a quantitative metric that correlates with the increasing clinical significance of changes to trainee preliminary report impressions by attending radiologists during report finalization.

(SS01-02) 2:10 PM
Discrepancy Rate of CT Pulmonary Angiogram Interpretations between On-Call Radiology Resident and Attending Radiologist

Cheng Ting Lin, MD, *Stony Brook University Medical Center, Stony Brook, NY*; Eric J. Feldmann, MD; William H. Moore, MD★ *(Cheng.Lin@sbumed.org)*

PURPOSE: This study examines the discrepancy rate between the radiology resident's preliminary and the attending radiologist's finalized interpretations of CT pulmonary angiograms. Cases with discrepant diagnoses were further interpreted by another blinded board-certified cardiovascular radiologist.

METHOD AND MATERIALS: A retrospective chart review was carried out following IRB waiver under the quality assurance stipulation. For a 12-month period starting in July 2007, we evaluated cases of CT pulmonary angiograms that were interpreted by the on-call radiology residents. Significant discrepancy was dichotomously defined as differences in preliminary and official diagnoses of pulmonary embolism. Such cases were further interpreted by a blinded board-certified cardiovascular radiologist.

RESULTS: A total of 278 cases were collected in the 12-month period. Preliminary interpretations were provided by 49 (18%) 2nd-year residents, 181 (65%) 3rd-year residents, and 48 (17%) 4th-year residents. Discrepancy in the diagnosis of pulmonary embolism was found in eight (3%) cases, while consensus was found in the remaining 270 (97%) cases. Among interpretations by attending radiologists, 40 (14%) reported the presence of pulmonary emboli, 233 (84%) found the exam unremarkable for pulmonary embolism, and five (2%) were equivocal or nondiagnostic for the presence of pulmonary embolism. Suboptimal contrast bolus led to limited evaluation in three (38%) of the eight discrepant cases. Subsequent blinded attending interpretation was in consensus with the radiology resident's interpretation in six (75%) cases.

CONCLUSION: We found a low discrepancy rate (3%) between radiology resident and attending interpretations of CT pulmonary angiograms, with an even lower rate (0.7%) when using a third blinded attending as the gold standard.

(SS01-03) 2:20 PM
Variability in the Extent of Edits Made by Attending Radiologists to Trainee Radiology Reports

David E. Surrey, BS, *Thomas Jefferson University, Philadelphia, PA*; Richard E. Sharpe, Jr, MD, MBA; Richard J. Gorniak, MD★; Levon N. Nazarian, MD; Vijay M. Rao, MD; Adam Flanders, MD★

PURPOSE: The purpose was to use a quantitative metric to describe the extent of report edits made by attending radiologists during report finalization over a large number of imaging examinations.

METHOD AND MATERIALS: An automated system using open-source document comparison software was used for analyzing the quantity of edits made by attending radiologists to preliminary reports. The Levenshtein distance (LD), the number of changes required to convert a preliminary report to the final report, was calculated for all reports performed from a 6-month time interval. The Levenshtein percent (LP) (which is the ratio of LD/the longest of preliminary or final report total character length) was calculated to normalize for report length among reports.

RESULTS: The analysis included 232,915 radiology examinations in every imaging modality and body region. The report average Levenshtein percent (ALP) for all report pairs was 6.38 (95% confidence interval, 6.32–6.43). The 25th and 75th percentile ALP values were 0 and 11.06. The ALP range for individual trainee radiologists was 0%–27.2%. The ALP range for attending radiologists was 0%–49.1%.

CONCLUSION: On average, a relatively small number of changes are made by attending radiologists during report finalization. The range of average percent of edits made was much wider for attending radiologists than for trainee radiologists. This finding suggests more variability in the extent of editing behaviors among attending radiologists than variation in the quality of preliminary reports submitted among trainees. Some attendings making large numbers of edits may not be efficiently allocating their time, and attending staff who never edit reports may have too lax an approach to their educational responsibilities.

RESEARCH PAPERS

(SS01-04) 2:30 PM
Improving Curricula for "Residents as Teachers" in Radiology

Madelene C. Lewis, MD, *Medical University of South Carolina, Charleston, SC*; Leonie Gordon, MBChB *(lewism@musc.edu)*

PURPOSE: Residents are expected to teach, as stated in regulatory requirements from the Liaison Committee on Medical Education (LCME), Accreditation Council for Graduate Medical Education (ACGME), and Association of American Medical Colleges (AAMC). Despite these requirements, most programs do not provide the tools necessary for residents to develop their teaching skills. Many studies have reported that formal instruction enables residents to become more effective teachers. "Residents as teachers" curricula are common in specialties such as internal medicine, surgery, and pediatrics but are not widely used in radiology, perhaps secondary to the unique challenges that radiology encounters in teaching medical students compared to other specialties. The purpose of this study was to survey residents, program directors, and fellowship directors at the Medical University of South Carolina regarding "residents as teachers" training curricula.

METHOD AND MATERIALS: Study participants were residents, program directors, and fellowship directors at the Medical University of South Carolina. Participants completed an online survey assessing the prevalence and structure of current curricula for preparing residents to become effective teachers.

RESULTS: One-hundred forty-seven residents, 19 program directors, and seven fellowship directors completed the survey. The vast majority of resident respondents stated that they teach medical students (120/145 [83%]). Only 31% of residency and fellowship program directors (8/26) have a formal method for teaching residents and fellows teaching skills. Only half (51%) of resident respondents receive feedback on their teaching skills (74/146). Of the programs with established curricula, most use large group lectures (63%), grand rounds (75%), and/or small-group sessions (50%).

CONCLUSION: Despite the regulations and evidence supporting formal resident teacher training programs, few residency programs currently provide this training. All radiology residency programs should develop formal curricula for teaching residents to become effective teachers adapted to the practice of radiology. At our institution, we created a "Residents as Teachers Toolkit" on the graduate medical education Web site.

(SS01-05) 2:40 PM
A Novel Means to Evaluate Residents and Monitor Rotational Utilization of Residents through Use of a Relative Value Unit Model

Kandarp Bhatt, MD, *University of Nebraska Medical Center, Omaha, NE*; Matthew DeVries, MD; Tina Hunter *(mdevries@unmc.edu)*

PURPOSE: There are two sides to radiology training, the academic/"book-smart" side and the practical/"get the work done" side. Traditionally, residency programs have been very good at evaluating the former with conferences, in-service exams, and board exams. However, not much emphasis has historically been placed on monitoring the latter. With this in mind, we wanted to develop and implement a tool that could quantitate the day-to-day workload that radiology residents experience.

METHOD AND MATERIALS: Using departmental billing information, not only were we able to track a specific resident's relative value units (RVUs), but we were also able to track total sectional RVUs. We then generated rotation-specific reports that allowed residents to see where they stood in terms of productivity when compared to their peers on the same rotation. Furthermore, in tracking total sectional RVUs, we could gauge how much of the day-to-day work actually goes through a resident (ie, how resident dependent was any given rotation).

RESULTS: Over the last year, resident-specific and rotation-specific RVU data were collected. Much to the surprise of residents, we calculated that less than 50% of the total departmental work actually went through a resident. We were also able to identify a "top" RVU producer in each class, although of note, no statistical outliers in any class were found in terms of production. It should be kept in mind that results should be taken with a grain of salt, as the validity of RVU data in residency evaluations, to our knowledge, has not been studied.

CONCLUSION: A resident's ability to handle daily workloads is often overlooked in the evaluation process. With this in mind, we began using

resident RVU information and rotation total RVU data to serve as an evaluation tool for program directors when assessing how residents are progressing in relation to their peers, as well as when gauging the "resident dependence" of any given rotation. As an aside, this topic has generated great interest and candid discussions with residents about the potential of using this as a springboard into nonclinical lectures or sessions dealing with topics such as "accounts receivable," fair compensation, and group practices in regard to bonus structures.

(SS01-06) 2:50 PM
Is High-Fidelity Medical Simulation a Useful Adjunct in Preparing Radiologists to Treat Contrast Reactions?

John M. Webb, MD, BS, *University of California-Davis, Sacramento, CA*; Eva Escobedo, MD; Wayne Monsky, MD, PhD *(john.webb@ucdmc.ucdavis.edu)*

PURPOSE: The purpose was to compare standard didactic training to standard didactic training plus training on a high-fidelity medical simulation system as training methods for radiology residents in the management of acute contrast reactions.

METHOD AND MATERIALS: The participants, thirty 1st- to 4th-year radiology residents, received didactic lectures detailing the spectrum of contrast reactions and the institutional protocols for treating these reactions. After a multiple-choice written examination testing baseline knowledge, the participants were stratified by year and randomly assigned to one of two groups. The control group underwent no additional training. The simulation group underwent additional training on a high-fidelity mannequin with a simulated patient exercise. Seven weeks later, all subjects participated in a practical examination using the high-fidelity mannequin and a unique contrast reaction scenario. With no prior knowledge of the exercise, each resident was summoned by pager to the CT suite and asked to evaluate a patient experiencing a contrast reaction. Prior to beginning the exercise, subjects retook the baseline written examination to test knowledge retention. Two evaluators scored the residents' performance independently, using a checklist of the actions deemed critical in the management of the event. The time to complete the scenario was also recorded. At the end of the practical examination, the participants completed a self-assessment questionnaire giving their current level of comfort in treating contrast reactions.

RESULTS: Seventeen of 30 residents completed the study. There was no statistically significant difference in written exam scores or in score change between the two groups. The simulation group scored higher (33.3 vs 25.9 of 37) on the practical examination ($P = .0012$).

CONCLUSION: We found no correlation between performance on the written examination and performance on the practical examination, suggesting that performance on a written examination does not necessarily translate into success in treating a real patient. Our study showed that the addition of training on a high-fidelity mannequin improves practical examination performance and, by extrapolation, performance in treating a real patient.

(SS01-07) 3:00 PM
Assessment of On-Call After-hours Experience: Educational Value and Satisfaction of Medical Students and Radiology Residents in a Radiology Clerkship at a Level I Trauma Center

Judith K. Amorosa, MD; M. Prapti Y. Shingala, BA; Lauren Summerton, AA; Lily Y. Zou, BA, *University of Medicine and Dentistry of New Jersey, New Brunswick, NJ*; Carol Sarokhan, BA, MD *(amorosa@umdnj.edu)*

PURPOSE: We wanted to evaluate medical student satisfaction, educational value, and experience during a 4-week elective diagnostic radiology clerkship. We tabulated 120 written evaluations of medical students and the radiology residents with whom medical students took call from 5 to 10 PM. Since this was a pilot program, the educational value and the insights by the students into after-hours radiology were the purpose of this evaluation. The medical students and residents had a standard evaluation form and room for comments.

METHOD AND MATERIALS: The resident and medical student evaluation forms were tabulated. Each student was evaluated according to the six basic competencies. This on-call experience was mandatory twice during the 4-week elective. The time of the on-call period was 5–10 PM, or a weekend

day could be substituted. Grading was on a 1–5 scale, from poor to outstanding performance. Residents were asked their opinion about medical students being on call. The medical students were asked about their experience about educational content, communication, and level of respect.

RESULTS: Over 95% of medical students found on-call experience excellent to outstanding, according to their comments, with excellent practical point-of-care experience. They felt respected by the resident and felt that they were part of the team. The residents found the medical students on call to be somewhat helpful, not making their call more difficult. They have described what could be done by medical students within limits.

CONCLUSION: On-call time by medical students, a long-standing educational experience in other clinical clerkships such as medicine, surgery, ob-gyn, and pediatrics, has been piloted in our elective radiology clerkship at a level I trauma center, with a high degree of satisfaction by the medical students and enthusiasm by radiology residents.

(SS01-08) 3:10 PM
Assessment of Resident-run Role-oriented Introductory Sessions for New Radiology Residents

Kara G. Udager, MD, *University of Michigan, Ann Arbor, MI*; Katherine E. Maturen, MD; Daniel Barr, MD; Kuanwong Watcharotone; Janet E. Bailey, MD *(kgaetke@umich.edu)*

PURPOSE: Incoming radiology residents must rapidly assimilate a large amount of new technical, anatomic, pathologic, and operational information. This can be overwhelming and contribute to anxiety and performance problems. Typical introductory curricula focused on radiologic content may not address the concerns of new residents.

METHOD AND MATERIALS: Two consecutive classes of new radiology residents participated. For groups A ($n = 11$) and B ($n = 11$), faculty gave the existing introductory lecture series, focused on medical content. In addition, for group B, a resident-initiated intervention was performed: Roundtable sessions were given for each of 12 resident rotations (two rotations added to the previous 10). These sessions included a resident-run discussion and reading room tours with faculty, with emphasis on roles, personnel, and work flow. With IRB exemption, residents were confidentially surveyed before and after the sessions regarding awareness of responsibilities, familiarity with relevant anatomy/pathology, and anxiety level regarding rotations on a 1–4 scale. Free-text comments were collected. Comparison of responses before and after the lecture series was performed by using the Wilcoxon rank sum test.

RESULTS: Group A reported increased awareness of their role ($P = .04$), greater content familiarity ($P = .05$), and decreased anxiety ($P = .02$), each in one of 10 rotations. Group B reported increased awareness ($P = <.01$ to .01) and decreased anxiety ($P = <.01$ to .05) in three of 12 rotations and improvement in either role awareness ($n = 2$; $P = .02–.04$) or anxiety ($n = 4$; $P = .01–.03$) in six rotations. Free-text commenters preferred the resident-run portions of the sessions.

CONCLUSION: The addition of role-oriented introductory sessions to existing lectures for 1st-year residents decreased subjective anxiety regarding most rotations and increased role awareness for half of the rotations, impacting many more parameters than the introductory lectures alone. These findings suggest that anxiety and, by inference, adjustment to radiology residency may be better addressed by role-oriented content than medically focused curricula alone. Further, resident-to-resident teaching may have additional benefits of content relevance and resident comfort.

> ### AUR Joseph E. and Nancy O. Whitley Award

(SS01-09) 3:20 PM
Teaching Management of Contrast Reactions: Does It Work, and How Often Do We Need to Refresh?

Andrew T. Trout, MD, *Cincinnati Children's Hospital Medical Center, Cincinnati, OH*; Richard H. Cohan, MD★; James H. Ellis, MD★; Shokoufeh Khalatbari, MS *(trout.andrew@gmail.com)*

PURPOSE: The purpose was to improve training in the management of reactions to contrast material through an assessment of the educational value and durability of a lecture and scenario series.

METHOD AND MATERIALS: Our institution provides an annual contrast reaction course that is mandatory for all trainees. The course consists of didactic lectures followed by hands-on scenarios. All residents and fellows participating in the course were asked to participate in this study. Knowledge was assessed with rotating 15-item quizzes concerning the recognition and management of contrast reactions. Confidence in managing a reaction to contrast material was assessed with a 5-point Likert scale. Assessments were administered immediately before and after the course and then at 1, 3, 6, and 9 months after the course.

RESULTS: Seventy-six trainees (44 residents, 32 fellows) participated. At baseline, 1st-year residents who had no prior training in the management of contrast reactions had significantly lower confidence scores than the other trainees. Time as a predictive variable was significantly associated with both knowledge and confidence in the management of reactions (both $P < .0001$). Both knowledge and confidence scores were significantly improved immediately following the course and remained improved at 1 and 3 months. By 6 months, both knowledge and confidence scores remained improved ($P < .0001$); however, scores had declined significantly relative to those obtained immediately following the course ($P = .0241$). By 9 months, only confidence scores remained improved over baseline ($P = .0356$).

CONCLUSION: A combined lecture and hands-on scenario series, as it is conducted at our institution, significantly improves confidence in and knowledge of the management of contrast reactions among participating residents and fellows. The effect of this training wanes by 6 months after the course, suggesting the need for reinforcement at that time.

Wednesday, March 21, 2012
2:00–3:30 PM

SS02: Scientific Session 2
Education II
Location: Grand Oaks Ballroom G
Moderators: Angelisa M. Paladin, MD
Judith K. Amorosa, MD

ED

(SS02-01) 2:00 PM
Teaching Physics to Radiology Residents for the Exam of the Future: The Approach at the Medical University of South Carolina

Kevin N. Blackmon, MD, *Medical University of South Carolina, Charleston, SC*; Walter Huda, PhD★; Madelene C. Lewis, MD; Sameer Tipnis, PhD; Eugene Mah *(huda@musc.edu)*

PURPOSE: The purpose was to describe the changes in both content and presentation methodology of the physics education for radiology residents preparing for the exam of the future in 2013.

METHOD AND MATERIALS: A "Foundations of Radiological Physics" course was introduced to explain the basics of x-ray–based imaging and provide an understanding of ionizing radiation. Traditional lectures were replaced by Web-based modules using prerecorded lectures with overlaid PowerPoint presentations (Tegrity) and a secure educational Web site (WebCT) and were combined with online tests. Each online module was accompanied by a noon conference to provide a forum for discussing problem areas and to assess residents' understanding of physics by using an audience response system (TurningPoint).

RESULTS: Six modules were developed to explain x-ray–based imaging (Matter/Radiation, X-ray Production, X-ray Interactions, Image Formation, Image Characteristics, and Image Quality). Six modules address the safe management of radiation (Dosimetry, Radiation Biology, Human Radiation Risks, Protecting Workers, Population Doses, and Protecting Patients). Provision of online tests helped residents consolidate their understanding of radiological physics and provided program directors and physics educators a valuable tool to monitor the progress of each individual resident. Use of an audience response system in noon conferences was very beneficial for both residents and physics educators. All (100%) of the participants ($n = 8$) preferred the Web-based course to a more traditional lecture-style format after completing the course.

CONCLUSION: The "Foundations of Radiological Physics" course was well received by all residents and will enable residents to learn x-ray–based imaging modalities (radiography, mammography, fluoroscopy, interventional radiology, and CT) during future rotations.

RESEARCH PAPERS

(SS02-02) 2:10 PM
Residents' Perceptions of a Novel End-of-Rotation Evaluation Method

Allison M. Grayev, MD★, *University of Wisconsin, Madison, WI*; Timothy Ziemlewicz, MD; David H. Kim, MD★; Amy Romandine; Jessica B. Robbins, MD *(agrayev@uwhealth.org)*

PURPOSE: At our institution, a novel end-of-rotation (EOR) evaluation tool has been developed that strives to prepare residents for the new American Board of Radiology (ABR) core examination while emphasizing the importance of maintaining verbal and written communication skills. The purpose of this study was to assess residents' perceptions regarding the educational value of this activity.

METHOD AND MATERIALS: All residents (*n* = 31; 28 advanced and three categorical) are required to participate in the mandatory EOR evaluation. The evaluation consists of three sections: an online computer-based image-rich examination (to simulate the new ABR core examination), a sample dictation (to reinforce the importance of written communication skills), and a short case-based oral examination (to maintain the practice of oral communication). Informed consent was obtained; residents were asked to complete a quarterly online 16-question survey. Each survey consists of 15 questions with Likert scale responses and one free-text answer. The data were collected quarterly, starting in September 2011.

RESULTS: Preliminary data indicate that the residents view the experience favorably. At the time of presentation, there will be ample data to provide a true representation of the residents' attitudes toward the program.

CONCLUSION: Initial data indicate that residents find a novel end-of-rotation assessment to be a useful educational exercise. Anecdotal reports indicate that it encourages residents to focus on the rotation and allows them to better direct their individual learning plan.

(SS02-03) 2:20 PM
"Flip" Teaching of Radiology: Flip or Flop?

Benjamin Plotkin, MD, *Harbor-UCLA Medical Center, Torrance, CA*; Michael L. Richardson, MD *(mrich@uw.edu)*

PURPOSE: Advances in video capture and distribution methods have enabled a new style of teaching known as "flip" teaching, in which direct instruction is moved from the classroom to the home, by using teacher-produced screencasts. Traditional "homework" exercises are moved to the classroom, where student-teacher interaction and personalized contact can be maximized. These techniques can be adapted to radiologic education—we are compiling a library of short, focused Web-based radiology lectures. We review the goals, advantages, and techniques of flip teaching, as well as the technology necessary to produce the online components.

METHOD AND MATERIALS: Short (5–10-minute) screencasts are captured by using inexpensive screen-capture software such as Camtasia (PC or Mac), ScreenFlow (Mac), or Explain Everything (iPad). Lectures can be slide based (PowerPoint or Keynote) or given as a traditional "chalk talk" by using a graphics tablet (Wacom). Lecture audio is recorded as text, and graphics are displayed. Completed screencasts are hosted on YouTube, iTunes U, departmental servers, and other sites. These screencasts are employed via various teaching models, such as the "classic flip," the "explore-flip-apply," and other models.

RESULTS: Our initial lectures focus on basic principles of bone tumor diagnosis. We currently use the "classic flip," in which residents view screencasts at home, followed by a later case conference where they can apply these principles to multiple unknown cases. Early resident reviews are encouraging. Data collection includes resident feedback, module usage patterns, and suggestions for future modules.

CONCLUSION: Online exemplars such as *khanacademy.org* have pointed the way to what is possible with this type of instruction. Flip teaching of radiology is not about replacing teachers with online videos but is about maximizing interaction and active learning during face-to-face time. An online archive of lectures allows residents to personalize their learning and to view teaching materials at their own speed, with unlimited opportunity for pauses, note taking, and review.

(SS02-04) 2:30 PM
Integrative Mind-Brain Medicine: A 12-Week Integrated Neuroimaging, Neurology, and Psychiatry Course for 3rd-Year Medical Students

Jill E. Springer, BS, *Brigham and Women's Hospital, Boston, MA*; Tracey A. Milligan, MD; Jane I. Epstein, MD; Donald N. DiSalvo, MD; Peter D. Clarke, MD; Srinvasan Mukundan, MD, PhD★ *(smukundan@partners.org)*

PURPOSE: The purpose was to develop a novel integrated approach for teaching neuroimaging, neurology, and psychiatry.

METHOD AND MATERIALS: An interdisciplinary neuroimaging, neurology, and psychiatry course was developed for 3rd-year medical students at Brigham and Women's Hospital, Harvard Medical School (HMS), to introduce an integrative approach to mind-brain disorders. Historically, the radiology, neurology, and psychiatry core clerkships have remained separate and distinct, despite occurring in a consecutive 3-month block. The course consists of hour-long weekly sessions over 12 weeks, organized into three 4-week modules. The first module contains an overview and visionary interactive sessions with leaders in the fields of neuroradiology, neurology, neuropsychiatry, and neurosurgery. The next two modules present clinical topics and have included stroke, epilepsy, neuro-oncology, and traumatic brain injury. Each clinical module is presented from the perspectives of neuroradiology, neurology, and neuropsychiatry and culminates with a patient-based conference. Faculty members from various brain-related specialties, including radiology, neuroradiology, psychiatry, neuropsychiatry, neurology, neurosurgery, and neuropathology, were involved in the design and teaching of the course.

RESULTS: Students (*n* = 55) were surveyed after each lecture and at the end of the 12-week block. The overall course assessment was rated on a 1–5 Likert scale (1 = best). The students found the course well organized (2.0), faculty were accessible (1.8), teaching quality was excellent (1.7), and the course enhanced students' interest in subject matter (1.9), offered new material in the overall HMS curriculum (1.9), and promoted an integrated view of the material (1.9). The course overall rating was very high (1.9). In addition, for the individual sessions, 100% of the students agreed or strongly agreed that the session would help them care for patients (4.4) and should be continued for the following year (4.6) (5-point Likert scale; 5 = best). The patient-based sessions rated an average of 4.8 versus 4.6 for didactic sessions ($P < .05$).

CONCLUSION: This novel course is an effective and well-received approach for integrating the teaching of neurology, psychiatry, and neuroimaging.

(SS02-05) 2:40 PM
Fourth-Year Medical Student Opinions and Basic Knowledge Regarding the Field of Radiology

Charles Prezzia, *West Penn Allegheny Health System Campus of Temple University School of Medicine, Pittsburgh, PA*; Gregory A. Vorona, MD; Robin L. Greenspan, MD *(charles.prezzia@temple.edu)*

PURPOSE: The purpose was to examine current 4th-year medical student opinions of the field of radiology.

METHOD AND MATERIALS: After approval from our institutional review board, an e-mail invitation to participate in our survey was sent to the dean of students of 137 medical schools. Upon receiving approval, a second e-mail was sent to the deans, containing a hyperlink to our online survey to forward to their current 4th-year class. Survey responses were collected from 8/4/2011 to 9/26/2011.

RESULTS: A total of 444 fourth-year medical students from 37 medical schools participated (53.2% male, 46.8% female; 73.5% allopathic, 26.5% osteopathic). 89.0% of respondents indicated that they plan to enter a field other than radiology. 10.8% indicated that their medical schools require a dedicated radiology rotation. 34.9% indicated that they had completed a radiology rotation prior to our survey. 88.4% thought radiology often changes patient care or is at least as important as physical exam. Most medical students underestimated the risk of carcinogenesis of a single CT of the abdomen and pelvis by at least one order of magnitude (91.4%) and many by at least two orders of magnitude (72.9%). Most medical students indicated that they had never heard of the ACR Appropriateness Criteria® (77.0%). Medical students underestimated the potential risks of MRI, with only 58.3% aware that IV gadolinium can potentially cause nephrogenic systemic fibrosis, and 79.4% were aware of potential injury from metallic

projectiles. 40.4% of respondents thought that nonradiologist clinicians in specific specialties of medicine interpret their respective imaging studies as accurately or superiorly to a corresponding fellowship-trained board-certified subspecialty radiologist. Student opinions regarding teleradiology, radiologist lifestyle, and timing of a radiology rotation are also discussed.

CONCLUSION: Fourth-year medical students recognize the importance of radiology but are poorly informed regarding radiation and MRI safety and the ACR Appropriateness Criteria®, despite 34.9% having had a dedicated radiology rotation. Suggestions for future medical student radiology education will be discussed.

(SS02-06) 2:50 PM
The Johns Hopkins Horizontal Strand in Diagnostic Imaging: A 4-Year Educational Bridge from Classroom to Clinical Years

Donna Magid, MD, MEd, *Johns Hopkins University, Baltimore, MD (dmagid@jhmi.edu)*

PURPOSE: Our school of medicine has evolved a new curriculum encouraging early introduction and longitudinal continuity of topics and fields previously not encountered until clinical years, to encourage an inclusive perspective of how the many threads of learning coalesce into usable and retrievable knowledge. Two years into that process, the horizontal strand in diagnostic imaging is the most developed and has been the model for other emerging strands.

METHOD AND MATERIALS: Radiology starts the 1st week of school, presenting ten 4-hour sessions extrapolating anatomy and cadaver into clinical scenarios to underline key points and emphasize future utility. Preparatory and self-tutorial materials on our student-driven educational Web site use imaging to illustrate each anatomic topic. Voluntary review sessions run by radiology residents precede each exam. Radiology also gives step 1 review later in the 1st year. Students expressing interest are directed into the vertical advisory, with lists of potential mentors provided. Late 2nd-year radiology has a strong presence in "Transition to Wards," preparing for clinical rotations. Web site tutorials introduce basics of chest interpretation, requesting exams, the ACR Appropriateness Criteria®, "Kiddy Physics" for clinician and patient, and using contrast. Subsequent required clerkships each have introductory imaging PRECEDE modules on the Web site, further exploring specific differentials, procedures, and problems. The "Basic Elective" is geared to future nonradiologists and emphasizes how to consult and how to select studies and communicate with imaging and addresses safety and cost-benefit issues. Fourth-year radiology is active in match advising and preparation for interviews, with activities drawing applicants from many fields.

RESULTS: Radiology has become high visibility and highly engaged with student education and well-being. This attracts students to the field, establishes our value to future referring clinicians, and helps produce thoughtful, competent, and safe clinicians.

CONCLUSION: Integrating radiology into the curriculum from day 1 allows us to assert leadership, attract future residents, educate and bond with future referring clinicians, and ensure better future communication for optimal patient care and safety.

(SS02-07) 3:00 PM
Medical Student Radiology Curriculum: What Skills Do Residency Program Directors Believe Are Essential for Medical Students to Attain?

Kimi L. Kondo, DO★, *University of Colorado, Aurora, CO*; Mathew Swerdlow, MD *(kimi.kondo@ucdenver.edu)*

PURPOSE: The Liaison Committee on Medical Education (LCME) states that education be provided in diagnostic imaging but does not specify competencies. AMSER has published a National Medical Student Curriculum in Radiology that provides a compendium of possible topics. Consequently, individual schools must develop their own imaging curriculum. We are developing a 4-year longitudinal medical student curriculum. Our goal is to provide content relevant to the needs of future clinicians, most of whom will not become radiologists. The purpose of this study was to identify topics considered essential by the residency program directors who will be working with our graduates.

METHOD AND MATERIALS: A survey of medical student radiology curriculum topics was mailed to residency directors in emergency medicine (EM), family medicine (FM), internal medicine (IM), pediatrics (Peds), and general surgery (GS) programs that accepted our graduates from 2005 to 2010. Descriptive statistics for responses to individual items and by program (ie, EM, FM, IM, Peds, and GS) were calculated. The numbers of topics viewed as essential for graduates to know were summed. Differences in total number and individual topics by program were compared by using ANOVA.

RESULTS: Ninety-nine surveys were completed (51.3% response rate). The EM, FM, IM, Peds, and GS response rates were 53.3%, 50.0%, 52.8%, 53.7%, and 45.2%, respectively. Seven skills were considered essential by >90% of respondents. Program directors identified 18/28 topics as essential prior to beginning residency. The mean number identified as essential did not differ by program ($F_{4,93} = 0.732$; $P = .572$). Based on ANOVAs comparing each topic by program, the importance of six topics differed significantly. The need for knowledge of abdomen/pelvis CT showed the greatest difference, with almost twice as many GS directors finding the need for a "systematic approach to viewing" as others. Likewise, the need to "recognize common abnormal findings on abdomen/pelvis CT" was considered essential almost twice as often by GS and IM directors as by others.

CONCLUSION: There is high agreement among program directors regarding essential imaging topics. Topics considered essential by >60% should comprise our core curriculum, while those less essential can be included in elective or program-specific curricula.

> **AUR Memorial Award**

(SS02-08) 3:10 PM
Radiation Safety and Medical Education: Development and Integration of a Dedicated Educational Module into a Radiology Clerkship, Outcomes Assessment, and Survey of Medical Students' Perceptions

Nicholas A. Koontz, MD, *Indiana University School of Medicine, Indianapolis, IN*; Richard B. Gunderman, MD, PhD *(nakoontz@iupui.edu)*

PURPOSE: This study assesses the effect on medical student understanding of a new radiobiology and radiation safety module in a 4th-year radiology clerkship.

METHOD AND MATERIALS: A dedicated radiobiology and radiation safety module was incorporated into the 4th-year medical school radiology clerkship at our institution. Student understanding of the material was assessed via pretest and posttest. Statistical analysis was performed to assess the significance of changes in student performance. In addition, we surveyed student perceptions of the importance of this material in medical education and practice.

RESULTS: Monthly pretest mean scores ranged from 47.8% to 55.6%, with an average monthly pretest score of 50.3%. Monthly posttest mean scores ranged from 77.3% to 91.2%, with an average monthly posttest score of 83.9%. The improvement in exam scores after the educational intervention was statistically significant (all P values < .01).

CONCLUSION: The introduction of a new educational module can significantly improve medical student understanding of radiobiology and radiation safety.

(SS02-09) 3:20 PM
Medical Student Radiology Curriculum and Targeted Needs Assessment: How Do Recent Graduates Perceive Their Radiology Training?

Mathew Swerdlow, MD; Kimi L. Kondo, DO★, *University of Colorado, Aurora, CO (kimi.kondo@ucdenver.edu)*

PURPOSE: At our medical school, we are developing a 4-year longitudinal medical student radiology curriculum. A targeted needs assessment is essential to ensure that we provide training relevant to the needs of our graduates, most of whom will not pursue radiology as a specialty. The purpose of this study was to identify gaps and the imaging tasks which our graduates did not feel adequately prepared to handle.

METHOD AND MATERIALS: An online survey of 26 imaging tasks was developed from a literature review of medical student radiology curriculum topics. A Likert scale of 1 ("Not at all") to 4 ("Very well") was used to query the degree of preparation provided by our medical school education. Additional questions addressed satisfaction with exposure to radiology during the basic science and clinical years and whether the respondents

had taken an elective 4th-year radiology course. The survey was sent electronically to our class of 2010 in May of their intern year.

RESULTS: Fifty-seven interns completed the survey (43.2% response rate). For 15/26 tasks, they reported a score of 1 or 2, which we deemed inadequate training. While many were confident (reported score of 3 or 4) in their ability to recognize common abnormalities on chest x-rays (84%), most were not comfortable with abdominal/pelvic CT (27%), abdominal ultrasound (5%), or even bone/joint x-rays (26%). Only 47% reported knowing the radiation risks of the studies they ordered for their patients. Sixty percent of the interns felt that their exposure to radiology during years 1 and 2 was inadequate, with a decrease to 44% during year 4. Eighteen (32%) took a radiology elective, and all believed the radiology knowledge they learned helped them to care for their patients during their intern year; 63% of those who did not take a radiology elective thought that they should have.

CONCLUSION: Most of our class of 2010 graduates responded that they were not adequately prepared to perform over half of the imaging tasks we queried. Additionally, they felt that their exposure to radiology was inadequate during medical school, particularly during the first 2 years. This feedback reinforced our need for a longitudinal medical student radiology curriculum and helped identify areas for improvement.

Wednesday, March 21, 2012
2:00–3:30 PM

SS03: Scientific Session 3
Enhancing Imaging Standard of Care
Location: Grand Oaks Ballroom K
Moderators: Jenny K. Hoang, MBBS★
Qian Dong, MD

QA

(SS03-01) 2:00 PM
Declining Trend in CT Utilization among Patients Referred and Directly Admitted to a Level I Trauma Center from 2005 to 2009

Gabriel C. Fine, BA, MD, *University of Washington, Seattle, WA*; Bahman Roudsari; Kevin J. Psoter, MPA; Jeffrey G. Jarvik, MD, MPH★

PURPOSE: Previous studies have shown a dramatic increase in CT utilization in the United States. This has raised concerns regarding patient radiation exposure and increasing cost of care. A similar increase in CT utilization has not been observed at Harborview Medical Center (HMC), the only level I trauma center in the northwestern United States, from 2005 to 2009. In this study, we compared the use of CT studies between directly admitted and referred trauma patients at HMC during the same time period, to further evaluate the observed difference at our center.

METHOD AND MATERIALS: We linked HMC's trauma registry and billing department databases to obtain detailed information on resources utilized during each patient's hospitalization. Negative binomial regression was used to evaluate CT utilization between direct-admit and referral patients after adjustment for age, gender, race/ethnicity, mechanism and severity of injury, ICU admission, length of hospitalization, final disposition, and year of admission. We further evaluated utilization for each year of the study period by admission status.

RESULTS: A total of 27,270 patients were admitted to HMC (14,144 referral and 13,126 direct) during the study period. We observed statistically significant lower utilization rates for head (IRR, 0.78; 95% CI, 0.76–0.81), cervical spine (IRR, 0.57; 95% CI, 0.55–0.59), abdomen (IRR, 0.49; 95% CI, 0.47–0.51), thorax (IRR, 0.52; 95% CI, 0.50–0.56), pelvis (IRR, 0.67; 95% CI, 0.65–0.70), and maxillofacial (IRR, 0.81; 95% CI, 0.74–0.88) CTs in referral patients compared to direct-admit patients. Compared to 2005, we observed a decrease in CT utilization for head and thorax in both groups. A decrease in abdomen, pelvis, and cervical spine CT utilization rates was also observed for referral patients, with no change to a slight decrease for direct-admit patients.

CONCLUSION: Lower utilization rates were observed for referral compared to direct-admit patients during the study period, as well as overall decreased utilization. Possible contributors to these trends include

(a) increased availability of outside imaging studies for referred patients and *(b)* adherence to well-established imaging protocols, minimizing physician-level variability in orders.

(SS03-02) 2:10 PM
Radiology-trained Cardiovascular Imagers Are Less Competent Regarding Patient Safety and Quality Assurance Compared to Nonradiology Cardiovascular Imagers and All Other Physicians

Rajni Natesan, MD, MBA, *Northwestern University, Chicago, IL*; Richard E. Sharpe, Jr, MD, MBA

PURPOSE: Recent health policy changes place new emphasis on providing high levels of patient safety in the health care system and on ensuring that patients receive the highest quality of health care. Cardiovascular imagers' level of understanding of these topics is not known. This study seeks to quantify cardiovascular imagers' competence in the topics of patient safety and quality assurance, as well as describe their relative competence compared to all other types of physicians.

METHOD AND MATERIALS: An online survey was done of U.S. residency programs' faculty and trainees. Respondents rated their understanding of quality assurance and patient safety. Weighted-average responses were calculated by using a Likert scale: no knowledge = 0, trace knowledge = 1, below competent = 2, competent = 3, more than competent = 4, and highly competent = 5. Respondents indicated their specialty and level of training. Average competence was calculated. Aggregate response average across all topics was calculated and termed *quality and safety competence*. Respondents indicated their specialty. Cardiovascular imagers were subcategorized by training as "cardiac" (cardiologists, cardiothoracic surgeons), "neurological" (neurologists, neurosurgeons), "radiology" (diagnostic radiologists), "vascular" (vascular surgeons and general surgeons), and "all others."

RESULTS: Surveys were received from 3661 physicians. Respondents included 32 cardiac, 116 vascular, 152 neurological, 784 radiology, and 2577 other physicians. Weighted-average understanding for quality and safety competence was 2.95 for all respondents (3 = competence). Specialty subgroup analysis demonstrated the following quality and safety competence values: cardiac, 3.44; neurological, 3.03; all other physicians, 2.99; radiology, 2.85; and vascular, 2.55.

CONCLUSION: Radiology-trained cardiovascular imagers are less than competent regarding key patient and system considerations of quality assurance and patient safety. Dedicated training in these areas is advisable to respond to the changing needs of the health care marketplace.

(SS03-03) 2:20 PM
Iodine 131 Therapy and Authorized User Training: Creating Competent Authorized Users

Jon A. Baldwin, DO; Sharon L. White, PhD; Joseph C. Sullivan III, MD; Pradeep Bhambhvani, MD; Fathima F. Palot-Manzil, MBBS, *University of Alabama, Birmingham, AL*; Asim K. Bag, MBBS; et al *(jbaldwin@uabmc.edu)*

PURPOSE: Difficulty in meeting requirements to become an "authorized user," radiation safety events chronicled in the media, and a perceived lack of resident clinical competence have highlighted the need to create a program that ensures adequate training to protect patients, staff, and the public from harm from the use of radioactive materials. This project demonstrates development and implementation of a standardized curriculum with progressive metrics.

METHOD AND MATERIALS: A didactic and interactive curriculum on physiology, pathology, physics, radiation safety, consent communication, state and federal regulations, and clinical management was devised, incorporating scored computer modules and oral teaching sessions. Pre- and postrotation tests examined resident ability and confidence. Each resident documented hands-on radiopharmacy experience, therapy performance, and case follow-up reporting using the electronic learning portfolio on the E*Value system. Both 360° evaluations from faculty, physicists, RSO, and technologists and quiz scores were reviewed with trainees. A plan to enforce policies and remediate resident deficiencies in hours and knowledge was set to ensure authorized user eligibility.

RESULTS: Residents demonstrated improvement in scores on pre- and postrotation tests and on 360° evaluations of their progress. Evaluations submitted by patients indicate satisfaction in the resident's ability to communicate effectively. Despite this improvement, residents often could not document adequate long-term follow-up of therapy cases due to rotation time constraints.

CONCLUSION: This program required cooperation between the radiology chair and the nuclear medicine and radiology program directors. Improved resident training was demonstrated, producing more confident and effective authorized users. The program did prove to be time consuming for faculty, the program coordinator, and staff. Lack of long-term follow-up experience led to additional modules covering key clinical concepts.

(SS03-04) 2:30 PM
Interobserver Variability in Evaluating Posterior Subluxation and Glenoid Version in Athletic Shoulders on MR Imaging

Gaurav K. Thawait, MD, *Johns Hopkins University School of Medicine, Baltimore, MD*; Majid Chalian, MD; Alex Larsson; John A. Carrino, MD, MPH★; Avneesh Chhabra, MD★ *(gthawai1@jhmi.edu)*

PURPOSE: Glenohumeral instability is a major cause for posterior shoulder dislocation. This instability can be evaluated by measuring glenoid version/glenoscapular angle (GSA) and posterior subluxation. The validity of these measurements on MRI was evaluated by using interobserver variations.

METHOD AND MATERIALS: Shoulder MRI studies of 77 athletes (64 males, 13 females), with an average age of 32 years, were reviewed retrospectively. GSA refers to the glenoid retro-/anteversion, and PHHA refers to the posterior subluxation of the humeral head. GSA and the percentage of humeral head anterior to the middle of the glenoid fossa (PHHA) were measured on axial images by three trained observers.

RESULTS: Interobserver reliability was assessed by using intraclass correlation coefficient (ICC). Scores were interpreted on the basis of the values suggested by Shrout et al, with a score of 0–0.4 indicating poor reliability, 0.4–0.75 indicating moderate reliability, and a score of more than 0.75 indicating excellent reliability. The ICC scores for GSA among the three observers were above 0.75, while PHHA was above 0.9, suggesting excellent reliability.

CONCLUSION: The excellent ICC scores of GSA and PHHA show that these values are highly reproducible on MRI and offer excellent reliability. Thus, these parameters can be employed on routine shoulder MRI to assess glenohumeral instability in relation to clinical, surgical, and postsurgical evaluation.

(SS03-05) 2:40 PM
Comprehensive Up-front Stroke Imaging: Impact of Training and Quality Interventions on Key Turnaround Time Metrics during the 1st Year after Implementation

Andrew Nicholson, MD★, *Emory University, Atlanta, GA*; Ashley H. Aiken, MD; Fadi Nahab, MD; Kimberly E. Applegate, MD, MS★ *(nicholson@emory.edu)*

PURPOSE: It remains critical for radiologists to work within an integrated multidisciplinary team to track and optimize the timely treatment of acute stroke. Our institution began a comprehensive stroke imaging protocol with CT angiography (CTA) and perfusion (CTP) in July 2010. The purpose of this study was to evaluate the impact of several interventions on timely result reporting.

METHOD AND MATERIALS: A retrospective review was performed of important time metrics for acute stroke patients presenting 6 months before (January 2010–June 2010) and a year after implementation of a new stroke protocol (July 2010–July 2011). Specifically, start-to–CT imaging complete, complete-to–preliminary interpretation, order-to-preliminary, and door-to-preliminary times were investigated. Throughout the course of the study, several interventions were undertaken, such as the implementation of standardized order sets, technologist training, radiology resident workshops on processing perfusion data, and the addition of a stroke pager for the neuroradiology department.

RESULTS: Two hundred eighty acute stroke patients underwent CT (85 had a noncontrast head CT alone before stroke protocol implementation, and 195 had CTA and CTP). In the group receiving the noncontrast head CT alone, the mean door-to-preliminary time was 49 minutes, and

complete-to-preliminary time was 17 minutes. Initially, all times increased with CTA/CTP, as expected with implementation of a new protocol. Door-to-preliminary times averaged 135 minutes for the first 6 months and 90 minutes for the next 6 months and decreased to 63 minutes for the month of June 2011. Similarly, mean CT complete–to-preliminary times decreased from 50 to 24 minutes during the study period.

CONCLUSION: We identified and addressed the critical issues in the implementation of a stroke imaging protocol that result in delays of time-sensitive result communication. Such issues include technologist education on identification of intracranial hemorrhage, coordination and CT timing, and resident education on CT perfusion techniques. This experience may serve as a model for other institutions looking to enhance the value that radiologists provide in the work-up of acute stroke.

(SS03-06) 2:50 PM
Altered Excitation-Inhibition Balance in the Brains of Patients with Painful Diabetic Neuropathy

Myria Petrou, MBChB, *University of Michigan Medical Center, Ann Arbor, MI*; Rodica Pop-Busui; Bradley R. Foerster, MD; Richard Harris; Richard Edden; Steven Harte; et al *(mpetrou@umich.edu)*

PURPOSE: The purpose of this study was to assess differences in excitatory (glutamate/glutamine, or Glx) and inhibitory (γ-aminobutyric acid, or GABA) neurotransmitter levels by using MR spectroscopy in pain-processing regions of the brain in patients with painful diabetic neuropathy (pDN) and age-matched healthy control (HC) subjects.

METHOD AND MATERIALS: Seven pDN subjects (5 males, 2 females; mean age, 57.0 ± 8.5 years) and seven age- and sex-matched HC subjects (mean age, 57.7 ± 3.2 years) underwent 3-T MR spectroscopy (Philips Achieva 3.0T system). T1-weighted sequence was performed for MRS voxel placement and tissue segmentation. Voxels were 3.0 cm × 2.0 cm × 3.0 cm and were placed in the right anterior insula (AI), right posterior insula (PI), anterior cingulate cortex (ACC), and thalamus. Single-voxel point-resolved spectroscopy (PRESS; TR/TE = 2000/35 msec) and MEGA-PRESS experiments optimized for GABA (TE = 68 msec [TE1 = 15 msec; TE2 = 53 msec]; TR = 1.8 msec) were performed for each brain region. Cerebrospinal fluid correction was performed for each voxel after tissue segmentation of T1W images by using statistical parametric mapping software. Glx and GABA within each interrogated brain region were quantified in arbitrary institutional units by using LC model and in-house Matlab-based postprocessing software. Two-tailed independent sample *t* tests were used to assess for differences in GABA, Glx, and GABA/Glx ratios between groups.

RESULTS: Significantly higher mean Glx levels were present in the posterior insula of pDN subjects compared to HC subjects (10.5 ± 1.4 vs 7.4 ± 0.8; $P = .005$). Within the same region, mean GABA levels were significantly lower in pDN subjects compared to age-matched HC subjects (1.2 ± 0.08 vs 1.5 ± 0.07; $P = .012$). Glx/GABA ratios were also significantly elevated in the posterior insula in pDN subjects compared to HC subjects (8.6 ± 1.2 vs 5.2 ± 1.4; $P = .0017$). Glx/GABA ratios in the thalamus were also higher in pDN subjects (7.6 ± 2.6 vs 4.2 ± 0.9), with a trend toward statistical significance ($P = .06$).

CONCLUSION: These data suggest an excitatory/inhibitory neurotransmitter imbalance within the pain-processing network in patients with painful diabetic neuropathy. Further larger studies are needed to solidify these observations and assess changes in these metabolites with respect to treatment.

(SS03-07) 3:00 PM
Comparison of Radiologist Performance with Multislit Scanning Photon-counting Digital Mammography to Full-Field Digital Mammography

Elodia Cole, MS★, *Medical University of South Carolina, Charleston, SC*; Alicia Toledano★; Etta D. Pisano, MD★ *(pisanoe@musc.edu)*

PURPOSE: The purpose was to assess the performance of a multislit scanning photon-counting digital mammography system (PCM) in comparison to full-field digital mammography (FFDM) for the area under the receiver operating characteristic (ROC) curve (AUC), sensitivity, specificity, and feature analysis of standard-view mammography for women presenting for screening mammography, diagnostic mammography, or breast biopsy.

METHOD AND MATERIALS: A total of 133 women were enrolled in this study at two European medical centers, with appropriate IRB approval. Sixty-seven women with a preexisting (10–36 months) FFDM

RESEARCH PAPERS

mammogram were enrolled prospectively in the study. Another 66 women who underwent breast biopsy who had a PCM screening mammogram and diagnostic FFDM including standard craniocaudal (CC) and mediolateral-oblique (MLO) views of the breast with lesion were enrolled retrospectively. Case mix consisted of 49 cancers, 17 biopsy-proven benign cases, and 67 normal cases. Sixteen radiologists participated in the reader study and interpreted all 133 cases in both conditions. ROC curve and free ROC (FROC) curve analyses were performed for noninferiority of PCM compared to FFDM, using noninferiority margin Δ = 0.10. Feature analysis of the 66 cases with lesions was conducted with all 16 readers at the conclusion of the blinded reads. Dose comparison between systems was also performed.

RESULTS: ROC AUC of PCM was 0.947 (95% CI, 0.920–0.974), while the FFDM was 0.931 (95% CI, 0.898–0.964). FROC curve figures of merit were 0.920 (95% CI, 0.881–0.959) and 0.903 (95% CI, 0.858–0.948) for PCM and FFDM, respectively. Noninferiority P values for AUC, sensitivity (per case and per lesion), specificity, and average false positives per image were all $P < .001$. Noninferiority P value for FROC is $P < .025$, from 95% CI for difference. Feature analysis resulted in PCM being preferred to FFDM at least 70% of the time. The average mean glandular dose with PCM was 0.74 mGy and was 1.23 for FFDM.

CONCLUSION: Radiologist performance with photon-counting multislit scanning digital mammography is noninferior to full-field digital mammography, at an average 40% lower mean glandular dose.

(SS03-08) 3:10 PM
Characteristics of Uncertain Acute Pulmonary Embolism Diagnosis on CT Pulmonary Angiography Images: Review of 1660 Cases

Arash Bedayat, MD, *Brigham and Women's Hospital, Boston, MA*; Kanaku Kumamaru; Andetta R. Hunsaker, MD; Frank J. Rybicki III, MD, PhD★ *(arashbedayat@yahoo.com)*

PURPOSE: The purpose was to evaluate the characteristics of cases with an uncertain diagnosis of pulmonary embolism (PE) on CT pulmonary angiography (CTPA) images and to compare them to those with a certain PE diagnosis.

METHOD AND MATERIALS: Radiology reports from 1660 consecutive CTPA studies considered positive for PE (8/2003 to 3/2010) were retrospectively evaluated regarding the confidence of diagnosis. These reports were divided into highly versus less confident. Patient age, gender, comorbidities, length of total hospital stay, and therapies related to PE (anticoagulation and IVC filter placement) were obtained from medical records for all cases and were compared between groups.

RESULTS: A total of 10.5% (174/1660) of all reports were less confident regarding the diagnosis of PE. The reasons were severe noise (8.0%), motion artifact (28.2%), insufficient contrast opacification (23.0%), unclear clinical interpretation (36.2%), and other causes (4.6%). The less-confident diagnosis group had smaller suspected emboli compared to the more-confident diagnosis group: prevalence of segmental and subsegmental emboli = 64.9% vs 51.0% ($P < .001$). There were no significant differences in age and gender between groups, but when limited to the cases with smaller (segmental and subsegmental) emboli, patients in the less-confident diagnosis group had more comorbidities (coronary artery disease, hypertension, diabetes, and COPD) than the group with more-confident diagnoses ($P = .003–.023$). The group with less-confident diagnosis had longer hospital stays (median, 7 vs 6 days; $P = .018$). Patients in the uncertain diagnosis group received PE-related therapies less frequently (94.3% vs 98.4%; $P = .006$).

CONCLUSION: Roughly 10% of CTPA reports with an imaging suspicion have lower confidence regarding the presence of emboli. Patients with a less-confident diagnosis have significantly smaller emboli, more comorbidities, and longer total hospital stay and receive PE-related therapies less frequently.

(SS03-09) 3:20 PM
Spinal Malpractice Cases Derived from the Credentialing Data of 8401 Radiologists

Ronak H. Patel, BA; Stephen R. Baker, MD; Valdis Lelkes, BS, *New Jersey Medical School, Newark, NJ*; *(patelrh@umdnj.edu)*

PURPOSE: The purpose was to present prevalence, causes, and judgments in spinal musculoskeletal malpractice suits in a survey of 8401 radiologists.

METHOD AND MATERIALS: The malpractice histories of 8401 radiologists from 47 states were evaluated from credentialing data, required of all radiologists participating in the network of One Call Medical, Inc, a broker for CT/MR in workmen's compensation cases.

RESULTS: Thirty-two percent of the radiologists had at least one malpractice suit. Of the 4793 total claims, 13.3% (638) were related to the bones and soft tissue, and 33.9% of those 638 cases involved the spine. A total of 65.0% of spinal cases were settled in favor of the plaintiff. More than 90% of cases resulted from alleged failure to diagnose. A total of 55.1% (119) involved the cervical spine, with an average settlement of $485,383. Lumbar cases accounted for 13.4% of spinal suits, with an average settlement of $112,417. Thoracic cases accounted for only 12.5% of spinal cases and had an average settlement of $455,408.

CONCLUSION: Of the three spinal regions, the cervical spine was the most frequent anatomic site of a malpractice suit and, among all those cases settled, incurred the highest cost in judgment for the plaintiff.

Wednesday, March 21, 2012
2:00–3:30 PM

SS04: Scientific Session 4
Frontiers in Cancer Imaging and Treatment
Location: Grand Oaks Ballroom N and O
   Moderators: M. Victoria Marx, MD
                Srini Tridandapani, MD, PhD

[IR] [OI]

(SS04-01) 2:00 PM
Effect of Yttrium 90 Radioembolization on the Growth Rate of Colon Cancer Liver Metastasis

[FDA]

Hamid Chalian, MD★, *Northwestern Memorial Hospital, Chicago, IL*; Sandra M. Tochetto; Huseyin G. Tore; Vahid Yaghmai, MD

PURPOSE: The purpose was to assess the growth kinetics of liver metastases from colon cancer before and after radioembolization using yttrium 90 (^{90}Y) microspheres.

METHOD AND MATERIALS: This retrospective HIPAA-compliant study was approved by our IRB. Seventy chemorefractory liver metastases from colon cancer in 31 patients with two triphasic liver MDCT studies before and one after ^{90}Y treatment were included. Growth rate of liver metastases from colon cancer was assessed before and after ^{90}Y treatment by calculating the percent change, doubling time (DT), and reciprocal of doubling time (RDT) based on volume of metastases. Variables were reported as mean ± standard error. Paired Student's t test was used to compare the variables. The significance level was set at 0.05.

RESULTS: Mean volume (mL) of the hepatic colon metastases was 12.3 ± 2.8 mL, 22.2 ± 4.9 mL, and 18.0 ± 5.1 mL at first, second, and third MDCT imaging, respectively. Time interval between scans was 49 days (range, 25–97 days) before ^{90}Y treatment and 47 days (range, 23–172 days) after treatment. Tumor volume significantly increased before treatment ($P = .0001$). The ^{90}Y treatment significantly decreased tumor volume ($P = .0018$). Growth variables before ^{90}Y treatment were percentage change in volume (%) of 97% ± 21%, RDT of 9. 3 ± 0.9, and corresponding DT of 39 days. Growth variables after ^{90}Y treatment were percentage change in volume (%) of –25% ± 5.7%, RDT of –6. 8 ± 1.3, and corresponding DT of 54 days.

CONCLUSION: Yttrium 90 radioembolization treatment significantly reduces the growth kinetics of liver metastases from colon cancer.

AUR Trainee Prize: 2nd Place

(SS04-02) 2:10 PM
Percutaneous Cryoablation of Metastatic Lesions from Non–Small Cell Lung Carcinoma: Initial Survival, Local Control, and Cost Observations

Hyun J. Bang, MD, *Wayne State University, Detroit, MI*; Peter J. Littrup; Brandt P. Currier, BS; Dylan J. Goodrich; Lydia C. Klein; Jarret C. Kuo *(hyunjbang@gmail.com)*

PURPOSE: Multisite cryoablation (MCA) of metastatic non–small cell lung cancer (mNSCLC) was conducted to assess complications, local tumor recurrences, overall survival (OS), and preliminary cost-effectiveness estimates.

METHOD AND MATERIALS: Forty-nine CT- and/or US-guided percutaneous MCA procedures were performed on 60 tumors in 31 mNSCLC patients and were retrospectively analyzed. Average patient age was 69 years. Tumor location was grouped according to metastatic sites: liver, soft tissue (ie, retroperitoneal, superficial, or bone), and lung. Median OS was determined by using the Kaplan-Meier method and also defined life-years gained (LYGs). Estimates of MCA costs per LYG were compared with established values for best supportive care (BSC) and current systemic therapies.

RESULTS: The total number of tumors at each site and the number of times that cryoablation was performed at each site were as follows, retrospectively: 9 and 8 for retroperitoneal; 12 and 11 for superficial; 10 and 7 for bone; 9 and 7 for liver; and 20 and 18 for lung. A mean of 1.4 procedures per patient was performed, with a median clinical follow-up of 11 months. Major complication and local recurrence rates were 8% (4/49) and 8% (5/60), respectively. Median OS for MCA was 1.33 years, with an estimated 1-year survival of ~53%. Systemic therapy had been given before or after MCA in 84% of patients. MCA also appeared to be cost-effective, even when added to the cost of BSC or systemic regimens, with an adjunctive cost-effectiveness ratio (ACER) of $50,813–$88,879.

CONCLUSION: Multisite cryoablation of metastatic non–small cell lung cancer lesions is a well-tolerated treatment with low recurrence and complication rates, which appears to increase OS. MCA falls within the range of accepted cost-effectiveness standards and warrants further studies.

AUR Trainee Prize: 1st Place

(SS04-03) 2:20 PM
Radiographic Response to Intraarterial Therapies in Neuroendocrine Liver Metastasis Predicts Patient Survival Times

Vivek Gowdra Halappa, MD, *Johns Hopkins Hospital, Baltimore, MD*; Celia P. Corona-Villalobos, MD; Susanne Bonekamp, DVM, PhD; John Eng, MD; Diane Reyes, RN; Nikhil Bhagat, MD; et al *(ikamel@jhmi.edu)*

PURPOSE: The purpose was to evaluate if volumetric changes of diffusion-weighted (DWI) and contrast-enhanced MRI (CE-MRI) can assess early tumor response to intraarterial therapy (IAT) in neuroendocrine liver metastasis (NELM).

METHOD AND MATERIALS: This retrospective HIPAA-compliant study included 71 patients (39 men; mean age, 62 years) with NELM treated with IAT. MR imaging studies were performed before and 3–4 weeks after therapy. Index lesion was segmented to provide volumetric functional analysis of apparent diffusion coefficient (ADC) and contrast-enhanced MRI (CE-MRI) in hepatic arterial (HAP) and portal venous phases (PVP). We defined tumor response as increase in volumetric ADC ≥15% and decrease of volumetric enhancement in HAP of ≥25% or in PVP of ≥50%. Treatment response was recorded according to RECIST, mRECIST, and EASL. Patient overall survival (OS) was used as the primary end point after first IAT. Kaplan-Meier curves were used to stratify patients as responders and nonresponders, and significance was analyzed by log-rank test. The Cox regression model was used to calculate the hazard ratio (HR).

RESULTS: There was a significant increase in mean volumetric ADC (27%; $P < .0001$) and a significant decrease in mean volumetric enhancement in HAP (–25.3%; $P < .0001$) and PVP (–22.4%; $P < .0001$) 3–4 weeks after treatment. Patients who had ≥15% volumetric ADC increase

($n = 49$) after therapy had better prognosis compared with those who had <15% increase in volumetric ADC ($n = 22$) (log-rank $P < .002$), HR = 2.8 (95% CI = 1.42–5.61) for nonresponders. Patients who had ≥25% decrease in volumetric arterial enhancement ($n = 40$) or ≥50% decrease in venous enhancement ($n = 18$) also had better prognosis compared with those who had <25% decrease in volumetric arterial enhancement ($n = 31$), HR = 2.0 (95% CI = 1.09–3.95) for nonresponders, or <50% decrease in venous enhancement ($n = 53$), HR = 2.8 (95% CI = 1.09–7.23) for nonresponders (log-rank $P = .02$). There was no survival benefit in stratifying patients as responders or nonresponders based on RECIST, mRECIST, or EASL (log-rank $P < .442$, $P < .362$, and $P < .67$, respectively).

CONCLUSION: Volumetric functional MRI criteria may act as biomarkers of early response, indicating that these criteria may be important to incorporate into future NELM clinical trials.

(SS04-04) 2:30 PM
Characterization of Tumor Vascularity in Gliomas by Using MR Angiography at 7 T

Kevin King, MD, *University of Texas Southwestern Medical Center, Dallas, TX*; Craig Malloy; Ivan Dimitrov, PhD★; Elizabeth Maher, MD, PhD *(kevin.king@utsouthwestern.edu)*

PURPOSE: With advances in MR imaging, it is possible to evaluate the progression of tumor vasculature in primary brain tumors directly through noninvasive angiographic evaluation. Vessel shape abnormalities can precede the emergence of gadolinium enhancement by months, but visualization of vessels is constrained by the acquisition voxel size and signal to noise, which may be improved by scanning at higher field strength. As noninvasive monitoring of gliomas remains a significant clinical problem, we proposed to evaluate the ability of 7 T to depict tumor neovascularity.

METHOD AND MATERIALS: This study was approved by our institutional review board for human studies and is Health Insurance Portability and Accountability Act compliant. Informed consent was obtained for all subjects. To date, 10 subjects with untreated glial neoplasms were evaluated with 3D TOF MRA at 7 T on a scanner (Philips Achieva) with a 16-channel head coil. Imaging parameters are as follows: TR, 20; TE, 2.5; flip angle, 20°; acquisition matrix, 420 × 417; acquisition voxel, 0.43/0.43/1.20; scan %, 99.34; FOV, 180; flow compensation, MOTSA with five 3D volumes. Future work will involve comparison of scans with those obtained at 3 T and correlation of vascular morphology with clinical progression.

RESULTS: In all subjects, 7-T MR angiography visualized tumor vascularity. The tumors studied depicted a range of tumor vascular density. Tumors with higher vascular density tended to depict neovascularity throughout the tumor mass, as well as connections to major feeding vessels. Vessels were markedly abnormal, with a high degree of tortuosity and irregular branching patterns. Lesions with lower vascular density demonstrated primarily peripheral arterial feeders, with relatively less abnormal branching and tortuosity.

CONCLUSION: In primary brain tumors, 7-T MR angiography depicts finely detailed images of tumor vascularity. The morphologic information obtained may provide information regarding tumor progression, which will be assessed further in the next phase of our study.

AUR Trainee Prize: 3rd Place

(SS04-05) 2:40 PM
Value of True Whole-Body FDG PET/CT Scanning Protocol in Oncology: Optimization of Its Use Based on Primary Diagnosis

Ronnie Sebro, MD, PhD, *University of California, San Francisco, San Francisco, CA*; Miguel Hernandez-Pampaloni, MD, PhD; Carina Mari Aparici, MD *(ronnie.sebro@radiology.ucsf.edu)*

PURPOSE: Several fields of view (FOVs) are currently used for whole-body (WB) FDG PET/CT studies in oncology: *(a)* vertex to mid-thighs (WB-A), *(b)* base of skull to mid-thighs (WB-B), and *(c)* vertex to toes (true-WB). Most centers perform limited WB studies because there is little perceived clinical loss when compared to true-WB studies. We investigate what proportion of true-WB studies have findings that are outside of either WB-A or WB-B FOV that are suspicious for malignancy or may change clinical management stratified by primary malignancy. We hypothesize

RESEARCH PAPERS

that true-WB FOV studies may be most effective for staging and surveillance for some but not all primary malignancies.

METHOD AND MATERIALS: True-WB FDG PET/CT studies performed for staging and restaging of oncology patients at the San Francisco VA Medical Center were retrospectively reviewed. Lesions were considered suspicious if *(a)* standardized uptake value (SUV_{max}) was more than 2.5 and *(b)* the uptake was not part of normal biodistribution. All suspicious lesions identified from the vertex to the base of the skull (outside WB-A) and from the level of the lesser trochanter of the femurs to the toes (outside WB-A and WB-B) were documented.

RESULTS: Two hundred nine patients met inclusion criteria (300 examinations); 23/209 (11%) of patients had findings outside the limited FOVs. Disease extended beyond WB-A FOV in 15 patients (19 scans) and beyond WB-B FOV in 16 patients (20 scans). The most common primary malignancies with disease extending beyond the limited FOVs were melanoma, multiple myeloma, lymphoma, and stage IV renal cell, lung, bladder, gallbladder, and colorectal cancers. Lesions found beyond WB-A and WB-B did not change clinical staging/restaging of patients. True-WB changed management in only one patient (0.5%), who had an incidentally discovered brain metastasis.

CONCLUSION: True-WB imaging in FDG PET/CT oncology studies detected additional disease in 11% of the patients (23/209), providing more accurate information of disease burden. Nevertheless, these findings did not change the staging of these patients and changed clinical management in only one patient. True-WB imaging may be limited to evaluation of multiple myeloma, lymphoma, melanoma, sarcomas, and stage IV malignancies and when the primary lesion is outside the typical field of view.

(SS04-06) 2:50 PM
Volumetric Analyses of Functional Diffusion-weighted and Enhancement Maps: Predictive Imaging Biomarkers for Early Treatment Response to Intraarterial Therapies in Hepatocellular Carcinoma

Vivek Gowdra Halappa, MD, *Johns Hopkins Hospital, Baltimore, MD*; Susanne Bonekamp, DVM, PhD; Celia P. Corona-Villalobos, MD; John Eng, MD; Diane Reyes, RN; Nikhil Bhagat, MD; et al *(ikamel@jhmi.edu)*

PURPOSE: The purpose was to evaluate volumetric diffusion-weighted imaging (DWI) and contrast-enhanced MR imaging (CE-MRI) changes for assessing early (3–4-week) treatment response to intraarterial therapies in hepatocellular carcinoma (HCC).

METHOD AND MATERIALS: This retrospective HIPAA-compliant IRB-approved study included 177 lesions of HCC in 107 patients (85 male, 22 female; mean age, 64 years) with BCLC stages A (19), B (44), C (36), and D (8) treated with locoregional therapy. All patients had pretreatment and 3–4-week follow-up MRI with DWI and CE-MRI. Patients underwent one session of locoregional therapy between pretreatment and 3–4-week follow-up MRI. Tumors were segmented by using semiautomated software to provide volumetric functional analysis of DWI and CE-MRI. Statistical analysis included paired Student's *t* tests, overall survival was analyzed with Kaplan-Meier curves, and significance was assessed by log-rank test. Multivariate analysis using the Cox model was also performed.

RESULTS: There was a significant increase in mean volumetric ADC (mean, 20%; $P < .0001$) and a significant decrease in mean volumetric enhancement in the arterial (mean, –24.3%; $P < .0001$) and venous phases (mean, –34%; $P < .0001$) 3–4 weeks after treatment. Patients who had volumetric ADC increase of ≥20% and volumetric venous enhancement decrease of ≥50% had significant survival benefit compared to patients who had volumetric ADC increase of <20% (survival, 32 vs 19.4 mo; log-rank $P < .001$) and volumetric venous enhancement decrease of <50% (survival, 32.7 vs 20 mo; log-rank $P < .001$) on univariate analysis. Factors associated with favorable prognosis were response by volumetric ADC (hazard ratio [HR], 0.441; 95% CI, 0.242–0.802), response by volumetric venous enhancement (HR, 0.430; 95% CI, 0.220–0.839), and patients with BCLC A and B (HR, 0.308; 95% CI, 0.176–0.541).

CONCLUSION: Volumetric functional analyses of DWI and CE-MRI were able to differentiate patients as responders and nonresponders based on patient overall survival as the primary end point and thus can be utilized as early imaging biomarkers of treatment response and survival in patients undergoing intraarterial therapies in hepatocellular carcinoma.

(SS04-07) 3:00 PM
Performance of Endoscopic US-guided Fine-Needle Aspiration in the Management of Pancreatic Cystic Neoplasms

FDA

Hamid Chalian, MD⋆, *Northwestern Memorial Hospital, Chicago, IL*; Huseyin G. Tore; Vahid Yaghmai, MD

PURPOSE: The impact of endoscopic ultrasonography (EUS) on the management of pancreatic cystic lesions remains unclear. The aim of this study was to evaluate how EUS changes the management of pancreatic cystic lesions.

METHOD AND MATERIALS: This retrospective HIPAA-compliant study was approved by our IRB. One hundred three patients with pathologically proven cystic neoplasm of the pancreas (57 with mucinous cystic neoplasm [MCN] and 46 with intraductal papillary mucinous neoplasm [IPMN]) were identified. The results of EUS-guided fine-needle aspiration (FNA) were collected when available. FNA results were compared to final histological diagnosis.

RESULTS: EUS FNA was performed on 50 (49%) patients, including 30 (53%) with MCN and 20 (43%) with IPMN. According to the pathology report, 14 cysts were premalignant/malignant, and 36 were benign. The material was inadequate to provide a definitive diagnosis by EUS in 15 (30%) cases, including seven (23%) with MCN and eight (40%) with IPMN. Of 14 premalignant/malignant cysts, malignant potential was reported in 0/14 (0%) by EUS FNA. EUS FNA identified the benign nature of six (17%) pathologically proven benign pancreatic cystic lesions.

CONCLUSION: EUS FNA cannot reliably differentiate between benign and malignant nature of cystic neoplasms of the pancreas. EUS may have a limited role in the management of pancreatic cystic masses.

A³CR² Research Award

(SS04-08) 3:10 PM
Development of a Computer-assisted Detection Method for the Diagnosis of Cirrhosis

Hannu T. Huhdanpaa, MD, MSc, *University of Minnesota, Minneapolis, MN*; Christopher Douville, BS; Binu Enchakolody, MSc; Sven Holcombe, MS; Venkataramu N. Krishnamurthy, MD; Stewart C. Wang, MD, PhD; et al *(huhd0001@umn.edu)*

PURPOSE: There are distinct morphologic features of cirrhosis on CT examinations; however, impressions may be subjective. The purpose of this study was to identify quantifiable morphologic features that can aid in the diagnosis of cirrhosis using computer-assisted detection (CAD).

METHOD AND MATERIALS: One hundred sixty-seven abdominal CT examinations (51 cirrhotic and 116 noncirrhotic) were utilized. The cases were randomly divided into the training set ($n = 88$) and the validation set ($n = 79$). Each liver was segmented in a semiautomated fashion using Mimics software. The resulting liver surfaces were saved as mesh objects into a spatial Oracle database and analyzed for morphological markers of cirrhosis with MATLAB® algorithms developed for this study. This study focused on non–protocol-dependent parameters, with the intent to develop CAD suitable for incidental CT scans. For each liver, several parameters were evaluated for the entire liver surface as well as for five representative slices of each liver, defined as the slice with the left tip of the liver as well as two slices on either side. SAS statistical software was used to create logistic regression models predictive of cirrhosis. The models were built using the training set and evaluated using the validation set.

RESULTS: The best predictive model for diagnosing cirrhosis consisted of representative slice–bounding box slice ratio, representative slice tortuosity, liver bounding box mediolateral dimension divided by the liver surface area, and the following parameters, each adjusted by a division by the patient's body surface area: representative slice perimeter and surface area, liver surface area, and liver bounding box anterior-to-posterior and craniocaudal dimensions. With this model, we calculated an area under the receiver operating characteristic (AUROC) curve of 0.87 for the training set and 0.92 for the validation set.

CONCLUSION: This study supports the idea that morphological features of liver can be quantified and utilized for the development of CAD methods that can assist in the radiological diagnosis of cirrhosis.

(SS04-09) 3:20 PM
Sensitivity of a Computer-aided Detection Device for Lung Nodule Detection on Chest Radiography: A Reader Study

Ammar A. Chaudhry, MD, BS, *Stony Brook University Medical Center, Stony Brook, NY*; William A. Moore, MD, BS *(ammar.chaudhry@sbumed.org)*

PURPOSE: The radiographic diagnosis of lung nodules is associated with low sensitivity and specificity. A computer-aided detection (CAD) system has been shown to have higher accuracy in the detection of lung nodules. The purpose of this study was to assess the effect on sensitivity and specificity when a CAD system is used to review chest radiographs.

METHOD AND MATERIALS: Sixty-three patients, including 24 controls, who had chest radiographs and CT within 3 months were included in this study. Three radiologists were presented chest radiographs without CAD and were asked to mark all lung nodules. Then the radiologists were allowed to see the CAD region-of-interest (ROI) marks and were asked to agree or disagree with the marks. All marks were correlated with CT studies.

RESULTS: The mean sensitivity of the three radiologists without CAD was 16.1%, which showed a statistically significant improvement to 22.5% with CAD. The mean specificity of the three radiologists was 52.5% without CAD and decreased to 48.1% with CAD. There was no significant change in the positive predictive value or negative predictive value.

CONCLUSION: The addition of a CAD system to chest radiography interpretation statistically improves the detection of lung nodules without affecting its specificity, thus suggesting that CAD would improve overall detection of lung nodules.

Wednesday, March 21, 2012
2:00–3:00 PM

SS05: Scientific Session 5
Other Topics
Location: Grand Oaks Ballroom R and S
Moderator: TBD

`MA` `QA`

(SS05-01) 2:00 PM
Bayes Factors for the Radiologist: Why, Oh, Why? and How, Oh, How?

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

PURPOSE: Radiologists make complex and clinically important decisions based on incomplete information. They must combine information from multiple, sometimes contradictory tests and somehow integrate this into one summary result. This is usually done with a "seat of the pants" algorithm, based on one's own biases and experiences. Bayes factors allow one to perform this assimilation process in a much more objective and reproducible manner. They also allow calculation of posttest probability for patient populations with different disease prevalence. We have created a simple iPhone/iPad-based calculator to make this even easier.

METHOD AND MATERIALS: Bayes theorem has been used for centuries to calculate conditional probabilities, for example, the likelihood of a certain diagnosis, given certain imaging findings. This can be expressed by a simple equation: pretest odds × Bayes factor = posttest odds. Given the pretest likelihood of a diagnosis and the Bayes factor of a diagnostic test, one can then easily calculate the posttest likelihood of that diagnosis. A Bayes factor of 10–100 is strong evidence against the null hypothesis; >100 is decisive. Bayes factors can be easily derived from the sensitivity and specificity of a given test. Bayes factors can also be used to reconcile the results of different but contradictory imaging tests and findings.

RESULTS: Here are two examples: *(a)* Patient has knee pain and MR with meniscal extrusion but no frank tear of the medial meniscus. Bayes factor for extrusion = 10.7; thus, posttest odds of tear = 10.7 times the pretest odds. *(b)* Patient has abdominal pain, with CT positive for appendicitis but US negative. Bayes factor for positive CT = 8.7; Bayes factor for negative US = 0.26. Combined Bayes factor = 8.7 × 0.26 = 2.3. Thus, posttest odds of appendicitis are about twice the pretest odds.

CONCLUSION: In an uncertain world, physicians rely on their clinical judgment, which gives them a reasonable estimate of the pretest likelihood of a disease. Bayes factors make it easy to use known indices of imaging test performance to explicitly calculate posttest likelihoods and to integrate conflicting imaging findings and tests. Posttest likelihoods can be very helpful in treatment planning.

(SS05-02) 2:10 PM
Systematic Review of Diffusion-Tensor Imaging Test Accuracy Measures in Amyotrophic Lateral Sclerosis

Bradley R. Foerster, MD, *University of Michigan, Ann Arbor, MI*; Ben A. Dwamena, MD; Myria Petrou, MA, MBBCh; Brian Callaghan, MD; Cristina Churchill; Ruth C. Carlos, MD, MS★ *(compfun@umich.edu)*

PURPOSE: Amyotrophic lateral sclerosis (ALS) is a fatal disease, with a mean survival of 3–5 years. On average, there is a 1-year delay between symptom onset and diagnosis. Diffusion-tensor imaging (DTI) is a promising test to detect ALS pathologic changes. Using DTI, ALS studies have reported that fractional anisotropy (FA) decreases in the brain's corticospinal tract (CST). The purpose of this study was to perform a systematic review to estimate the test accuracy measures of DTI to diagnose ALS. The secondary aims were to investigate differences in test measures between MRI field strengths (1.5 T vs 3 T) and brain regions (internal capsule [IC] vs entire CST).

METHOD AND MATERIALS: We performed a computerized search to identify relevant articles in the MEDLINE, Embase, and CINAHL databases. Search keywords were "amyotrophic lateral sclerosis" and "magnetic resonance imaging or diffusion tensor imaging or fractional anisotropy." Study criteria were human studies using DTI region of interest techniques to compare FA values along the IC or CST between ALS subjects and healthy controls (HCs). Two authors independently evaluated each abstract/article for inclusion. The metan module in Stata v11 was used to perform the data synthesis.

RESULTS: The search yielded 1148 potential literature citations. We excluded 1118 of the studies based on study criteria. The 30 evaluated studies involved 561 ALS subjects and 530 HCs. For the overall 30 studies, the pooled sensitivity was 0.66 (95% CI, 0.60–0.70), the pooled specificity was 0.69 (95% CI, 0.61–0.73), the pooled diagnostic odds ratio was 1.92 (95% CI, 1.48–2.35), the pooled test effectiveness was 1.06 (95% CI, 0.82–1.30), and the area under the ROC curve was 0.77 (95% CI, 0.72–0.81). The AUCs demonstrated at least moderate heterogeneity (I^2 = 72; $P < .001$). There were no significant differences between the testing accuracy measures between 1.5 T vs 3.0 T or between CST vs IC.

CONCLUSION: The overall sensitivity and specific summary measures of DTI to diagnose ALS are relatively low, which is also reflected in the relatively low area under the ROC curve. The subanalyses suggest that higher MRI field strength does not improve diagnostic test measures and that the IC region is comparable to the average CST test results.

(SS05-03) 2:20 PM
Liver Lesions Discovered Incidentally on US: Evaluation of Reader Ability to Characterize Lesions on MR Imaging without Intravenous Contrast Material

Neil J. Hansen, MD, *University of Michigan, Ann Arbor, MI*; Ruth C. Carlos, MD, MS★; William J. Weadock, MD★; Ajay Morani *(neilhans@med.umich.edu)*

PURPOSE: The purpose was to evaluate the added effectiveness of contrast-enhanced MRI, compared to noncontrast MRI, to correctly guide management of liver lesions incidentally identified on ultrasound in patients with a low pretest probability of malignancy.

METHOD AND MATERIALS: Patients with no prior history of cancer or chronic liver disease with 2 years of clinical follow-up (72 patients) who had ultrasound-detected incidental lesions subsequently evaluated by MRI were identified after IRB approval. Fifty were randomly selected and analyzed by two abdominal radiologists. Initially, only nonenhanced images were reviewed; after 6 weeks, the complete exam findings, including the contrast-enhanced images, were viewed. Differences in interpretation between the noncontrast and contrast-enhanced reading sessions were assessed.

RESULTS: Sixty-nine patients (96%) had benign diagnoses accounting for the ultrasound findings. One patient was newly diagnosed with hemochromatosis, and two patients were diagnosed with metastases. The most

RESEARCH PAPERS

likely diagnosis changed for 15 of the lesions described by reader A and for 14 described by reader B. Most of these changes (90%) were from one benign entity to another; 10% of the changes involved that of a benign entity to a malignant one. Reader A recommended contrast-enhanced imaging in 26% of patients and reader B in 18%. After viewing the nonenhanced images, both readers had recommended that all patients with eventual malignancies should return for contrast administration and/or biopsy. After viewing the contrast-enhanced imaging, both readers accurately diagnosed all malignancies.

CONCLUSION: Most of the changes in lesion detection and characterization made after contrast administration were clinically insignificant. In the three lesions where clinically important differences were found, both radiologists recommended additional imaging or biopsy, leading to the correct diagnosis. None of the patients with malignancy were misdiagnosed either on noncontrast or contrast-enhanced imaging. This supports the utility of initially performing a noncontrast examination in the population with a low pretest probability of malignancy.

(SS05-04) 2:30 PM
Extremity Musculoskeletal Malpractice Cases Derived from the Credentialing Data of 8401 Radiologists

Ronak H. Patel, BA, *New Jersey Medical School, Newark, NJ*; Stephen R. Baker, MD; Valdis Lelkes, BS *(patelrh@umdnj.edu)*

PURPOSE: The purpose was to present the prevalence, causes, and judgments in nonspinal musculoskeletal malpractice suits in a survey of 8401 radiologists.

METHOD AND MATERIALS: The malpractice histories of 8401 radiologists from 47 states were evaluated from credentialing data, required of all radiologists participating in the network of One Call Medical, Inc, a broker for CT/MR imaging in workmen's compensation cases.

RESULTS: Thirty-two percent of the radiologists had at least one suit. Of the 4793 total claims, 13.3% (638) were related to the bones and soft tissue, and 66.1% of those 638 cases involved bones and soft tissues other than the spine; 66.3% of nonspinal cases were settled in favor of the plaintiff. More than 90% of cases resulted from alleged failure to diagnose. In nonspinal musculoskeletal claims, the foot and hip were most common, with 17.8% and 15.4%, respectively. The most frequently affected bone in the foot was the navicular, accounting for 36.2% of cases. The wrist ranked third in frequency, with 12.1% of nonspinal suits. Mean age at time of suit was highest for the shoulder at 51.9 years and lowest in the hand at 20.4 years. The highest mean payment occurred for the skull, with an average settlement of $238,750.

CONCLUSION: The foot and hip were the most common nonspinal sites of injuries in malpractice claims, but skull settlements incurred the highest awards. The bones most apt to result in malpractice claims were the scaphoid in the wrist and the navicular in the foot.

(SS05-05) 2:40 PM
Generational Differences in the Radiology Workplace: Factors Influencing Workplace Satisfaction among Practicing Radiologists

Andrew Moriarity, MD, *Henry Ford Hospital, Detroit, MI*; Manuel L. Brown, MD★; Chad Cogan *(andrewm@rad.hfh.edu)*

PURPOSE: Four generations currently compose the radiology workforce, each with perceived differences in motivational factors, values, and workplace preferences. These are the veteran generation (born 1925–1942), the baby boomers (1942–1960), generation X (1961–1981), and generation Y (1982–2001). We review important characteristics relating to work satisfaction and motivation among the generations and then identify factors influencing the differences among generations and among different subgroups of practicing radiologists.

METHOD AND MATERIALS: A total of 2163 online surveys were completed by using snowball sampling; 1809 respondents in active practice were analyzed. Chi-square tests were used to compare work satisfaction between genders and across generations. Multiple logistic regressions were used to test if generation was predictive of workplace satisfaction while adjusting for work situation and stratifying by gender.

RESULTS: A larger proportion of radiologists in the veteran generation were satisfied at work (91.9%), compared to baby boomers (77.8%) or generation X (80.8%); however, gender and administrative roles were not associated with work satisfaction. Work satisfaction was higher among generation X females (84.5%) and veteran generation males (92.8%). After adjusting for administrative roles, generation correlated with work satisfaction in males but not in females.

CONCLUSION: Trends in work satisfaction among different generations were unique to genders and not explained by administrative roles. These differences may relate to other factors, and further analysis of the survey data will be explored in our review. Subgroup investigation will include the role of part-time employment, academic-type practice setting, group size, self-reported important work factors, degree of difference in expected vs desired age of retirement, optimism for the general future of radiology, and optimism for the respondent's personal future in radiology.

(SS05-06) 2:50 PM
Benefits of an Education Program for Radiology Technologists in Prevention and Management of Adverse Events from Contrast Media

Jonelle M. Petscavage, MD, *Pennsylvania State Hershey Medical Center, Hershey, PA*; Heather Kaneda; Michael A. Bruno, MD

PURPOSE: The purpose was to design, implement, and measure the outcomes of a training program in adverse events from contrast media for radiology technologists. We hypothesized that the program would change practice, increase knowledge and confidence, and foster a teamwork approach between radiologists and technologists.

METHOD AND MATERIALS: A presession 10-question anonymous survey was sent to radiology residents to assess technologists' skills in handling contrast reactions. Open-ended comments were recorded from radiologists who had interacted with a technologist during a contrast reaction. A 45-minute PowerPoint interactive presentation was given by a radiology resident and attending radiologist. Anonymous 10-question pre- and posttests were administered. Technologists completed a subjective questionnaire assessment of the training using a Likert scale. Statistical analysis included Student's *t* test for differences between pre- and posttest scores.

RESULTS: The presession resident survey showed that only 42.8% of technologists knew the emergency response phone numbers for an adverse reaction, only 21.4% had the reaction box and vital sign monitors readily available, and only 54.3% completed required postreaction documentation. Seventeen CT technologists participated in the education program. There was a statistically significant improvement ($P < .05$) between mean pre- and posttest scores. On a 1–5 Likert scale (1 = completely agree; 5 = completely disagree), technologists felt that the session improved their knowledge (mean, 1.1), made them more comfortable managing a reaction (mean, 1.1), increased understanding of what is expected of them (mean, 1.4), and fostered confidence in recognizing symptoms of a reaction (mean, 1.4). The program was well received by the administration, which asked for an annual program.

CONCLUSION: Education of technologists with residents and radiologists in the prevention and management of adverse reactions to contrast media has several benefits. There is improvement in knowledge, increased comfort and confidence with subject material, and teamwork development. The education program serves as an opportunity for residents to gain experience in teaching and in PQI development. This program could easily be replicated at other sites.

Wednesday, March 21, 2012
2:00–3:30 PM

SS06: Scientific Session 6
RAHSR Session
Location: Cibolo Canyon Ballroom 8
   Moderators: Annette J. Johnson, MD, MS
             Pina C. Sanelli, MD, MPH

`QA`

(SS06-01) 2:00 PM
Can Iterative Reconstruction Techniques in Coronary CTA Reduce Image Noise and Allow Reduced Radiation Dose Compared with Traditional Filtered Backprojection in Obese Patients?

Gayatri Joshi, MD, *Medical University of South Carolina, Charleston, SC*; U. Joseph Schoepf, MD★; James Spears, BS; Jared Mills; Rozemarijn Vliegenthart *(joshig@musc.edu)*

PURPOSE: The purpose was to investigate the effect of an iterative reconstruction technique (IRT) on image noise in obese patients undergoing coronary CTA and to estimate the potential for radiation dose reduction compared to traditional filtered backprojection (FBP).

METHOD AND MATERIALS: Coronary CTA was performed in 55 patients, who were divided into obese (12 men; mean age, 54.6 ± 12.2 years; mean BMI, 37.1 ± 4.9 kg/m²) and nonobese (16 men; mean age, 61.4 ± 15.8 years; mean BMI, 26.1 ± 2.6 kg/m²) groups. Scans were obtained using retrospective ($n = 10$) or prospective ($n = 45$) ECG gating on a second-generation dual-source CT system. Image data were reconstructed with traditional FBP and an IRT (Iterative Reconstruction in Image Space [IRIS]; Siemens). Image noise was assessed in three regions of interest (ascending aorta [AscA], descending aorta [DescA], and interventricular septum [IVS]). Based on decreases in image noise, the potential for radiation dose reduction at maintained noise levels was estimated as noise reduction = square root of dose increase. Statistical analysis used paired two-tailed t tests.

RESULTS: The IRT reduced image noise in obese patients compared to FBP (AscA, 26.3 ± 12.5 HU vs 34.5 ± 13.3 HU; DescA, 27.9 ± 9.6 HU vs 39.8 ± 14.4 HU; IVS, 28.5 ± 11.4 HU vs 37.4 ± 14.7 HU; all $P < .001$). Reductions were also observed in nonobese patients (AscA, 16.9 ± 7.0 HU vs 22.4 ± 7.9 HU; DescA, 19.2 ± 7.2 HU vs 26.8 ± 10.8 HU; IVS, 18.5 ± 6.0 HU vs 24.0 ± 8.5 HU; all $P < .001$). Noise levels were higher for obese compared to nonobese patients ($P < .05$ for AscA and IVS). Absolute reduction in image noise with the IRT was greater in obese patients than in nonobese patients (AscA, 8.1 ± 4.8 HU vs 5.6 ± 3.0 HU; $P < .05$), while relative noise reductions were similar (~25%). Overall, effective radiation dose was 7.8 ± 5.1 mSv. Based on observed reductions in image noise with this IRT, we estimate a potential for radiation dose reduction of 43% in nonobese patients and 42% in obese patients at maintained levels of image noise.

CONCLUSION: The proportional suppression of image noise by iterative reconstruction and estimated reductions in radiation dose are similar in obese and nonobese patients, with larger absolute noise reductions for obese individuals. IRT in coronary CTA may allow considerable radiation dose reductions for both obese and nonobese patients.

(SS06-02) 2:10 PM
Improving Quality of Image Processing and Display: A Model for Reducing Errors

Gregory Czuczman, MD, *Massachusetts General Hospital, Boston, MA*; Ambrose J. Huang, MD *(gczuczman@partners.org)*

PURPOSE: Incorrect display and processing of radiologic images can hinder accurate interpretation. In the digital era, the infrequent to nonexistent interaction between technologists and radiologists reduces the opportunity for radiologists to provide live feedback to their technologists detailing such errors. We aim to show the impact of a Web-based feedback system upon the rate of image display and processing errors by using the axillary shoulder radiograph and shoulder CT multiplanar reformats as examples.

METHOD AND MATERIALS: Over approximately 18 months, musculoskeletal radiology staff used a Web-based form to report errors of diagnostic image quality across all imaging sites at a single institution. Commonly cited was incorrect display of the axillary shoulder radiograph (flipped or rotated), as well as incorrect reformation of coronal oblique and sagittal oblique shoulder CT images (performed with respect to the CT table). We retrospectively reviewed the error rates of these examinations immediately prior to and following the feedback period to determine if there was a significant reduction. Data obtained were analyzed with Fisher's exact test. Subset analysis was performed to identify sites with the highest error rates.

RESULTS: A total of 36 and 18 Web-based forms were submitted detailing incorrectly displayed axillary shoulder radiographs and incorrectly reformatted shoulder CT, respectively. In the period prior to the feedback interval, the axillary shoulder radiograph was displayed incorrectly in 368/1025 (35.9%) consecutive patients. Following the feedback period, the error rate decreased to 73/1016 (7.2%; $P < .0001$). One satellite outpatient imaging center demonstrated substantially more errors in image display, with 41/58 (71%) performed incorrectly. The error rate of shoulder CT reformatted images decreased from 12/122 (9.8%) to 3/112 (2.7%; $P < .05$).

CONCLUSION: A Web-based system for reporting errors in display and processing of imaging studies may be an effective mechanism to optimize quality and consistency of radiologic imaging studies.

(SS06-03) 2:20 PM
Reducing Radiation Dose for Chest CT Examinations: A Quality Improvement Project in a Large University Radiology Department

Mignonne B. Morrell, MD, *Louisiana State University Health Sciences Center-New Orleans, New Orleans, LA*; John Yang, MD; Joe Park, MD; Andrew Mai, MD; Anshu Duggal, MD; Aran M. Toshav, MD *(mbeaud@lsuhsc.edu)*

PURPOSE: At our institution, it became evident that a large number of CT examinations were being ordered inappropriately, particularly with regard to CT scans of the chest routinely being ordered both without and with contrast. As part of a department-wide quality assurance and quality improvement initiative, we analyzed the process of ordering CT scans and identified a list of problems within the system and barriers to a solution, in order to enact processes to address the underlying barriers.

METHOD AND MATERIALS: An evaluation of the current system and the steps leading to a CT being performed were analyzed. A list of problems was created, and solutions to address each problem were developed. A formal protocoling procedure was instituted in which appropriateness was evaluated prior to patient arrival in the department, without affecting throughput of the department. Appropriateness was determined by using the ACR Appropriateness Criteria®. A retrospective analysis of the PACS database of chest CT scans was performed to calculate and compare the percentage of chest CT scans performed without and with contrast relative to the total number of chest CT scans performed for 2-month intervals before (October–November 2010), immediately after (April–May 2011), and several months after (July–August 2011) institution of the protocoling procedure.

RESULTS: The total number of scans performed for each 2-month interval was not significantly different (342 in October–November 2010; 341 in April–May 2011; and 337 in July–August 2011). There was a 58.69% reduction in the number of chest CT scans being performed both without and with contrast in favor of a single-phase chest CT study over the April–May 2011 period in comparison to the October–November 2010 period. There was a 92.02% reduction in the number of chest CT scans being performed both without and with contrast in favor of a single-phase chest CT study over the July–August 2011 period in comparison to the October–November 2010 period.

CONCLUSION: A quality improvement framework can be used to effectively improve patient safety and departmental functioning within a large hospital system. Prospective protocoling can reduce unnecessary patient radiation exposure and hence the risk associated with increased radiation dose.

RESEARCH PAPERS

★ Faculty financial disclosures are located in the Faculty Index.

(SS06-04) 2:30 PM
Causes of Malpractice Suits against Radiologists in the United States

Stephen R. Baker, MD; Ronak H. Patel, BA; Valdis Lelkes, BS; Lyndon Luk, BS; *New Jersey Medical School, Newark, NJ (lelkesvm@umdnj.edu)*

PURPOSE: The purpose was to determine the most frequent causes of malpractice suits, as derived from credentialing data of 8401 radiologists.

METHOD AND MATERIALS: A total of 8401 radiologists in 47 states participating in the network of One Call Medical, Inc, a broker for CT/MR studies in workmen's compensation cases, were required to provide their malpractice history as part of their credentialing application. Of these radiologists, 2624 (31%) had at least one claim in their career. In each credentialing file, there was a narrative regarding every malpractice case, from which, in most instances, a primary allegation could be discerned. Of the 4793 cases, an alleged cause could be derived from the narrative in 4043 (84%).

RESULTS: The most common general cause of malpractice suits was an error in diagnosis (78% of suits with known cause). In this category, breast cancer was the most frequent missed diagnosis (27%), followed by fractures (16%), lung cancer (7%), and vascular disease (6%). The next most common cause of suits was procedural complications (9%), followed by inadequate communication with either patient or referrer (5%). In 5%, the radiologist had only a peripheral role. Failure to recommend additional testing was a rare cause (1.7%) of suits, and many of those were related to the evaluation of breast disease.

CONCLUSION: In a series encompassing nearly one-third of all radiologists in the United States, the leading cause of malpractice suits was errors in the diagnosis of breast disease. Failure to communicate and failure to recommend additional testing are both very uncommon reasons for the initiation of a suit.

> **RAHSR-ACR Award**

(SS06-05) 2:40 PM
Declining Trend in the Use of CT for Pediatric Trauma Patients in a Level I Pediatric/Adult Trauma Center

Bahman Roudsari, MD, PhD, *University of Washington, Seattle, WA*; Kevin J. Psoter, MPA; Gerald Palagallo; Jeffrey G. Jarvik, MD, MPH*

PURPOSE: The purpose was to evaluate the recent trend in utilization of computed tomography (CT) in pediatric trauma patients admitted to Harborview Medical Center (HMC) from 2005 to 2009.

METHOD AND MATERIALS: We linked the HMC trauma registry to the HMC billing department data and extracted the following variables: age, gender, race/ethnicity, insurance status, mechanism of injury, injury severity score, length of hospitalization, ICU admission status, final disposition, year of admission, and type and frequency of performed CTs. We classified age into three categories: 0–14, 15–18, and 19–54 years. Negative binomial regression was used to compare CT utilization rates among different age groups, considering 19–54 years as the baseline for comparisons. We further evaluated the trend in CT use for children and teenagers over the study period.

RESULTS: A total of 20,887 trauma patients aged 0–54 years were admitted over the study period. Compared to adults 19–54 years, children (<15 years) had significantly lower utilization of head, maxillofacial, thorax, pelvis, and lower extremity CTs; while teenagers (15–18 years) had significantly lower incidence of cervical spine, thorax, pelvis, and lower extremity CTs compared to the 19–54-year-old group. After adjustment for other variables, the use of maxillofacial and lower and upper extremity CTs did not change materially for children (<15 years). However, head (IRR, 0.70; 95% CI, 0.57–0.85), cervical spine (IRR, 0.76; 95% CI, 0.59–0.98), abdomen (IRR, 0.64; 95% CI, 0.49–0.85), pelvis (IRR, 0.62; 95% CI, 0.47–0.82), and thorax (IRR, 0.13; 95% CI, 0.05–0.29) rates were significantly lower in 2009 compared to 2005. Among teenagers (15–18 years), the use of head, maxillofacial, pelvis, abdomen, and upper and lower extremity CT remained relatively unchanged, and only cervical spine (IRR, 0.71; 95% CI, 0.52–0.97) and thorax (IRR, 0.37; 95% CI, 0.25–0.54) were lower in 2009 compared to 2005.

CONCLUSION: We observed a decreasing trend in utilization of CT in pediatric trauma patients after adjustment for potential patient and injury-related characteristics. This might be partially due to implementation of certain imaging guidelines that have been developed to decrease unnecessary CT use, especially among younger patients.

(SS06-06) 2:50 PM
Improved Patient Satisfaction with Interventional Radiology by Using Readily Available Techniques

Minhaj S. Khaja, MD, MBA; Nicholas Said, MD, MBA, *University of Virginia, Charlottesville, VA*; Alan H. Matsumoto, MD*; Auh Whan Park, MD; Wael Saad, MD; Saher S. Sabri, MD *(irmdmba@me.com)*

PURPOSE: Patient satisfaction is the difference between expectations before receiving care and the perception of that care after delivery. Because of rising competition in health care, the importance of patient satisfaction to gaining and maintaining market share has increased. Patient wait times can greatly affect satisfaction but are difficult to change. We aim to measure the impact of some easily implemented changes in practice, with respect to empathy, on overall patient satisfaction in a university-based interventional radiology (IR) department.

METHOD AND MATERIALS: All outpatients receiving IR services from 5/2008 to 7/2009 received a survey concerning the quality (5-point Likert scale) of patient registration, facilities, procedure outcome, personal issues, and overall assessment of their care. The responses were converted to a continuous variable. The Mann-Whitney U test was used to compare overall patient satisfaction responses for the 6-month periods before and after the practice changes. The following three low-cost practices were adopted by the IR department on 10/1/2008 to improve satisfaction without making large-scale changes: increased warm blanket use, manager interviews with randomly selected patients, and more consistent staff introductions.

RESULTS: A total of 433 outpatients were seen by the IR department; 229 patients returned the survey, for a response rate of 53%. The overall rating of care increased from 91.5% to 95.6% ($P < .01$). The likelihood of recommending IR services to others rose from 91.9% to 95.7% ($P < .01$). Satisfaction regarding wait times did not significantly change, as mean score increased from 81.4% to 83.7% ($P = .39$).

CONCLUSION: Previous reports show that patients' satisfaction with the quality of care and services they receive are as important as many clinical health measures. Measuring and applying patient satisfaction data help identify ways to improve a practice, ultimately translating into improved care and happier patients. By using a combination of available low-cost factors such as increased warm blanket use, manager interviews, and staff introductions, the IR department significantly increased overall patient satisfaction, even in the face of lagging wait time satisfaction.

(SS06-07) 3:00 PM
Patient Preferences Regarding Direct Communication of Imaging Results: A Survey

Lillian K. Ivansco, MD, *Emory University, Atlanta, GA*; Tiffany Easter; Carolyn C. Meltzer, MD*; Kimberly E. Applegate, MD, MS* *(llkim@emory.edu)*

PURPOSE: The IOM recommends redundant communication of test results to patients to improve safety and health literacy. Many health systems are creating Web-based patient portals that will provide lab test results, but few include radiology results. Our institution is piloting direct radiology results reporting among liver transplant patients undergoing abdominal MRI exams. Prior to pilot launch, we surveyed this population to assess perspectives on results reporting.

METHOD AND MATERIALS: After IRB approval, we mailed a five-question survey to 521 patients in the liver transplant program. The survey featured 5-point Likert-like scaled questions, including "When you undergo radiology exams, how satisfied are you with the manner in which the results are communicated to you?" Subjects also were asked to rate their interest in using a Web-based patient portal to access exam results and to rank in order of importance several criteria for results communication, including clarity of test follow-up instructions, timeliness of receipt of results, use of lay language, and delivery of results by the referring clinician vs the interpreting radiologist.

RESULTS: One hundred responses (19% response rate) were received. Two-thirds of respondents (66%) reported being satisfied or very satisfied

with receiving radiology exam results from referring clinicians. However, 81% of respondents also endorsed wanting results directly from the interpreting radiologist. Just over half (53%) indicated interest in using a Web-based patient portal to access radiology results. Timeliness and use of lay language were the most important factors with respect to results communication. The communication source, whether the clinician or the radiologist, was less important.

CONCLUSION: Most survey respondents said they welcome receiving radiology results directly from radiologists and placed less emphasis on who delivers exam results and more on when and how those results are communicated. These findings demonstrate unexpected patient preferences that we must understand as radiology departments and health systems move forward with direct communication and online patient portal initiatives.

(SS06-08) 3:10 PM
Gastrointestinal Malpractice Cases Derived from the Credentialing Data of 8401 Radiologists

Stephen R. Baker, MD; Hye-In Choi, BS, *University of Medicine and Dentistry of New Jersey-New Jersey Medical School, Newark, NJ*; Lyndon Luk, BS; Jeremy Whang, MD; Christian Curcio *(bakersr@umdnj.edu)*

PURPOSE: The purpose was to determine the prevalence, causes, and outcomes of GI malpractice suits in a survey of 8401 radiologists.

METHOD AND MATERIALS: The malpractice histories of 8401 radiologists from 47 states were evaluated from credentialing data, required of all radiologists participating in the network of One Call Medical, Inc, a broker for CT/MR in workmen's compensation cases.

RESULTS: Thirty-two percent of the radiologists had at least one suit. Of the 4073 total claims, 9.7% (394) were related to the gastrointestinal system; 61.2% (241) resulted from failure to diagnose and 15.0% (59) from procedural complications. Failures to diagnose primary cancer, pneumoperitoneum, and appendicitis were the most common—30.7% (74), 18.7% (45), and 15.8% (38), respectively. A total of 75.4% of the claims involving primary cancer, 80.0% of the pneumoperitoneum cases, and 68.0% of the appendicitis cases resulted in payment to the plaintiff. The average payment awarded for primary cancer was $639,093, for pneumoperitoneum was $368,548, and for appendicitis was $225,413. Of the procedurally related claims, 20.4% (19) involved failure to recognize a retained foreign body, 18.3% (17) involved performance of a barium enema, and 15.1% (14) involved complications of liver biopsy. A total of 70.6% of claims regarding a foreign body, 75.0% of barium enema cases, and 70.0% of liver biopsy suits resulted in a payment to the plaintiff. The average award was $51,138 for foreign body retention cases, $295,795 for barium enema, and $749,833 for liver biopsy.

CONCLUSION: Of the GI malpractice claims, failure to diagnose primary cancer was the most prevalent. Misdiagnosis of pneumoperitoneum most frequently resulted in a payment to the plaintiff. Among procedurally related cases, claims concerning liver biopsy resulted in the highest average payment.

(SS06-09) 3:20 PM
Stealth and the Sinus CT: A Practice Quality Improvement Project for Radiation Dose Reduction, Decreased Repeat Scanning, and Improved Referral Satisfaction

Jackie L. Edwards, MD, *Ohio State University Medical Center, Columbus, OH*; Gabriel Chiappone, MBA, RT; Amna Ajam; Richard Gray; Michael Luttrull; Claudia F. Kirsch, MD★

PURPOSE: The aims of this practice quality improvement (PQI) project were *(a)* to retrospectively determine whether a lower-dose standardized CT paranasal sinus Stealth protocol was of diagnostic quality, compared to standard technique, as reviewed by board-certified neuroradiologists (*n* = 4); *(b)* to standardize paranasal sinus Stealth CT protocols on multiple scanners at our institution, reducing the radiation dosage; and *(c)* to prospectively initiate low-dose Stealth protocols on all preoperative sinus CTs ordered by ENT physicians, preventing incorrect non-Stealth studies being inadvertently performed, necessitating repeat Stealth scanning for localization in the operating room.

METHOD AND MATERIALS: A total of 18 paranasal sinus CTs with dose reduction were randomized and retrospectively reviewed (nine Stealth protocol; nine standard protocol). All scans were optimized for dose reduction (12 cases, GE scanner; 8 cases, Seimens scanner). Scans

were obtained in the axial plane with reconstruction algorithms performed in coronal and sagittal planes. Four board-certified neuroradiologists (A.A., R.G., C.F.K., M.L.) blinded to the type of technique reviewed the image diagnostic quality. Referring ENT physicians were polled regarding implementation of the low-dose Stealth technique for all preoperative sinus CT requests.

RESULTS: Optimization of the paranasal standard and Stealth sinus protocols resulted in a radiation dose reduction of approximately 20%. All four neuroradiologists were blinded to the type of study (standard vs Stealth). All scans were determined to be of diagnostic quality, with images being deemed to be useful enough to render an appropriate radiologic report. Initial implementation in our institution of scanning with only Stealth technique has been met with an overwhelmingly positive response from the referring ENT physicians.

CONCLUSION: The optimization and use of a lower-dose standardized paranasal Stealth CT protocol yielded scans that were retrospectively determined to be of diagnostic quality, resulting in a 20% reduction in radiation dose to the patients. Initial prospective evaluation has resulted in a decrease in repeat scanning and improved ENT physician referrer satisfaction.

★ Faculty financial disclosures are located in the Faculty Index.

Notes

AUR 2012 Research Poster Abstracts

Research posters are located in Grand Oaks Ballroom J. Each poster will be presented by its author during
AMA PRA Category 1 Credit™ poster sessions scheduled for 7:00–8:15 AM, Tuesday and Wednesday.
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 1st-year fellows) are noted in **burnt orange.**

(R-01) Tuesday ● 7:00 AM
Identification of Esophageal Thickening on Multidetector CT: Do Clinicians Follow Radiologists' Recommendations to Further Evaluate for Esophageal Cancer or Esophagitis?

(FDA)

Hamid Chalian, MD★, *Northwestern University, Chicago, IL*; Vahid Yaghmai, MD; Jeanne M. Horowitz

PURPOSE: The purpose was to assess the impact of radiologists' recommendations on the management of patients with esophageal thickening on multidetector computed tomography (MDCT).

METHOD AND MATERIALS: One hundred patients for whom esophageal thickening was reported on MDCT were identified by using a radiology report search engine. MDCT reports were reviewed to see if the radiologist recommended that the patient should receive further evaluation for the esophageal thickening, such as an esophagram or endoscopy. Patients' charts were reviewed to see if the patient underwent an esophagram, endoscopy, or clinical evaluation for this CT finding. The McNemar test and κ study were used for analysis.

RESULTS: The male/female ratio was 58/42, with a mean age of 60 ± 14 years. Radiologists recommended further evaluation for 42/100 (42%) of patients. Only 12/42 (29%) received any more evaluation for their esophageal thickening identified on CT. Radiologists did not specifically recommend further evaluation for 58/100 (58%) patients. However, 14/58 (24%) received further evaluation. There is a significant difference between the radiologists' recommendations for further evaluation of patients with esophageal thickening and how clinicians follow them (P = .023). Agreement between radiologists' suggestions and clinicians' actual patient management is poor (κ = 0.047).

CONCLUSION: How clinicians manage patients with esophageal thickening identified on CT does not correlate with the radiologists' recommendations.

AUR Trainee Prize: 1st Place

(R-02) Wednesday ● 7:00 AM
Pseudoenhancement in Multidetector CT of Liver Masses: Implications for Assessing Viability

(FDA)

Hamid Chalian, MD★, *Northwestern University, Chicago, IL*; Huseyin G. Tore; Vahid Yaghmai, MD

PURPOSE: Currently, an increase of 10 HU is considered enhancement of viable liver tumors. The purpose of our study was to assess the contribution of pseudoenhancement to changes in attenuation of liver masses after administration of contrast material.

METHOD AND MATERIALS: This HIPAA-compliant retrospective study was IRB approved. Liver cysts were used as a model of nonenhancing masses. Forty-four liver cysts in 18 patients with triphasic liver MDCT were included. All lesions were larger than 10 mm and were proved to be cysts by MRI (n = 37 [84%]) or US (n = 7 [16%]). Lesion attenuation was measured on nonenhanced and arterial and portal venous phases with a centrally placed ROI covering as much area of the cyst on axial plane as possible. Care was taken to avoid the cyst wall. ROI area was kept constant on different enhancement phases. The liver parenchyma was used as a model of enhancing liver mass. Parenchyma attenuation was also obtained by a constant ROI through different phases. Paired t test was used to compare the attenuation values over different phases. ROC curve analysis

was performed by using the parenchyma and cyst attenuation increase between nonenhanced and portal venous phase to define the cutoff point for enhancement of viable tumors.

RESULTS: Mean value for cyst size was 29 ± 28.7 mm. Cyst attenuation increased in a stepwise fashion (nonenhanced, 9.9 ± 7.9 HU; arterial, 12.3 ± 9.1 HU; portal venous, 15.8 ± 10.0 HU) as the parenchyma attenuation increased from nonenhanced (60.4 ± 6.7 HU) to arterial (89.0 ± 19.2 HU) and portal venous (125.0 ± 16.7 HU) phases. Cyst attenuation was significantly different among the three MDCT phases (P < .001 in all instances). Pseudoenhancement was found in two cysts (4%) on arterial phase and in eight cysts (18%) on portal venous phase. A value of 17 HU was found to be the most sensitive (100%) and specific (100%) cutoff point for enhancement on the portal venous phase.

CONCLUSION: Hepatic cyst attenuation increases about 3 HU for every 30-HU increase in background attenuation. Eighteen percent of liver cysts enhanced more than 10 HU on the portal venous phase in our cohort. A value of 17 HU may be a better cutoff point for defining enhancing liver masses on portal venous phase.

(R-18) Wednesday ● 7:00 AM
Evaluation of an Ultralow-Dose Chest Noncontrast CT Protocol

Lee Nakamura, MD, *University of Texas Medical Branch, Galveston, TX*; Douglas Hughes, MD *(imnakamu@utmb.edu)*

PURPOSE: The purpose of our investigation was to determine whether the quality of our ultralow-dose noncontrast chest CT protocol is sufficient for follow-up of indeterminant lung nodules.

METHOD AND MATERIALS: Maintaining standard kilovoltage, we lowered our tube current–time product to 20 mAs. Using data collected from 200 chest CT exams over the last 6 months, we used multiple objective measurements and also subjective interpreter assessment to evaluate the quality of the exams.

RESULTS: Results revealed that evaluation of the lung parenchyma is not hindered by lowered radiation dose.

CONCLUSION: We conclude that noncontrast ultralow-dose chest CT is adequate to evaluate for changes of indeterminant lung nodules.

(R-20) Wednesday ● 7:00 AM
Education Is Appropriate: A Multispecialty Physician Survey of Knowledge and Utilization of the ACR Appropriateness Criteria®

Kerry L. Thomas, MD, *University of South Florida, Tampa, FL*; Ryan M. Harvey, MD, BS; Jennifer N. Kucera, MD, MS; Rajendra Kedar, MD

PURPOSE: Imaging utilization is not always evidence based, and clinicians are often unaware of resources to assist in imaging decision making. We aimed to assess awareness and attitudes regarding the ACR Appropriateness Criteria® among physicians.

METHOD AND MATERIALS: We introduced the ACR Appropriateness Criteria® to physicians at our institution with an educational presentation. We discussed methods for accessing the ACR Appropriateness Criteria® and reviewed imaging utilization guidelines for sample clinical scenarios. Before and after the presentation, a questionnaire investigated awareness, utilization, and attitudes regarding the criteria, as well as issues related to legal liability and imaging.

RESULTS: Respondents included 23 radiologists and 75 clinicians across specialties and ranged from PGY-1 through attending level. Prior to the presentation, only 15% of nonradiologist clinicians were aware of the ACR Appropriateness Criteria®, and only 4% reported utilizing them. On

the questionnaire after the educational session, all respondents indicated understanding of how to access the resource, and 100% felt that it would be helpful in practice. Forty-six percent of participants anticipated consulting the criteria "occasionally." PGY-1 and PGY-2 trainees indicated more "frequent" anticipated use. Ninety-four percent of respondents indicated a compulsion to image for medicolegal reasons, with 42% indicating that they were "somewhat compelled" or "highly compelled" to do so. All (100%) agreed that evidence-based guidelines would mitigate that compulsion.

CONCLUSION: Awareness and utilization of the ACR Appropriateness Criteria® are low across clinical specialties and training levels. Our results demonstrate disparity between the lack of knowledge of the criteria and the very favorable perception of their utility. Once educated, clinicians, particularly younger trainees, indicate a high likelihood of incorporating the resource into their practice. All participants indicated that evidence-based guidelines for imaging utilization would lessen the pressure to order studies for medicolegal reasons. Our study suggests an opportunity to increase evidence-based imaging utilization by engaging in outreach to educate nonradiologists about this resource.

(R-23) Tuesday ● 7:00 AM
Routine Postoperative Upper Gastrointestinal Radiography after Gastric Bypass: Needed or Not?

Gregory Coffman, MD, *Delgado Community College, New Orleans, LA (gcoffm@dcc.edu)*

PURPOSE: The purpose of this study was to determine the necessity of upper gastrointestinal (GI) tract radiography after gastric bypass surgery. Because of the complication risk from Roux-en-Y gastric bypass, upper GI radiography is used to screen patients for perforation of the GI tract and other postoperative complications. The current postoperative protocol at many programs is to study bariatric patients who receive gastric bypass with upper GI radiography on postoperative day 1. However, there are clinical signs that patients are having complications.

METHOD AND MATERIALS: The efficacy of upper GI endoscopy after gastric bypass was determined by using a retrospective study design. Data were gathered via medical records of patients who had previously received an open or laparoscopic Roux-en-Y gastric bypass at Ochsner Clinic Foundation. Primary outcome variable was any patient who has been found to have an anastomotic leak, delayed gastric emptying, gastric outlet obstruction, or fistula formation, either by radiographic analysis or operative exploration. Secondary outcome variables were any of the clinical signs of postsurgical complications, including tachycardia, fever, abdominal pain, nausea, vomiting, and oliguria.

RESULTS: Seven hundred patients were identified who met the inclusion criteria. Of the 700 patients, five instances of delayed gastric emptying or gastric outlet obstruction were identified. All of these complications were found by using clinical techniques, including an evaluation on progress and a brief physical. Once the signs and symptoms of the gastric outlet obstruction or delayed gastric emptying were found in the patient, the radiologic evaluation confirmed the diagnosis. One instance of gastric leak was found at the gastrojejunal anastomosis on postoperative day 21. This complication was also confirmed with gastric swallow study.

CONCLUSION: The routine use of upper GU radiography is a wasteful and unneeded procedure after gastric bypass surgery. The use of upper GI swallow study should be reserved as a confirmatory test after proper clinical evaluation.

(R-24) Wednesday ● 7:00 AM
Exposure to Errors in Radiology Residency: Untapped Opportunity for Quality Improvement in Radiology?

Christina M. Cinelli, MD, *Johns Hopkins, Baltimore, MD*; Jennifer R. Kohr, MD; Ruth C. Carlos, MD, MS★; Paul G. Nagy, PhD *(ccinell1@jhmi.edu)*

PURPOSE: The purpose was to assess radiology resident and program director awareness of the types and frequency of errors in their program and to gather suggestions for possible practice quality improvement (PQI) projects.

METHOD AND MATERIALS: An online survey was sent to the ACR Resident and Fellow Section (RFS) membership in December 2009 and April 2010 and to the APDR in April 2010. The survey was voluntary and anonymous. Questions used a Likert 4-point scale. IRB approval was obtained prior to performing descriptive analyses and summarizing the data.

RESULTS: Responses mirrored locations of U.S. programs, representing 143 different residencies; 45% of program directors and 12% of residents responded. The most common types of errors identified by residents and program directors are incorrect study ordered (94.3%), study improperly executed (80%), incorrect interpretation (78.3%), wrong study performed (78%), and critical finding not relayed (54.8%). Residents report that they are the ones most likely to detect errors, whereas program directors report that faculty are. When asked how to report an error in their department, 44% of residents and 41.3% of program directors were either not sure or indicated no system existed to document errors. A total of 32% of residents and 32% of program directors entered free-text data of specific usable examples of not only errors that could be prevented, but also processes that could be improved with systems-based practice and PQI projects. Limitations include resident survey at two different time points, anonymous responses, and responder self-selection.

CONCLUSION: Residents are aware of the types and frequency of errors that occur in their program and can suggest feasible PQI projects to decrease these errors and improve radiology practice, yet our results show that many programs either do not have systems in place to report errors or, if present, trainees and faculty are not aware of them. This represents both an untapped resource for quality improvement in radiology departments, as well as an opportunity to increase resident training and participation in department quality improvement.

(R-27) Tuesday ● 7:00 AM
The Business of Radiology: Insurance Denials—How to Turn No into Yes

Kathleen T. Hudson, MD, *University of Tennessee Graduate School of Medicine, Knoxville, TN*; Michael Langenberg, MBA; Garnetta Morin-Ducote, MD *(khudson@utmck.edu)*

PURPOSE: The purpose of this presentation is to describe a method of resident and faculty education to promote appropriate dictations for proper coding of radiology studies.

METHOD AND MATERIALS: Lectures on "The Business of Radiology" have been a quarterly presentation to our radiology residents for the past several years. The business manager for the radiology group selects topics of interest and those with timely business implications. To decrease denials for payment by insurance companies, a three-prong approach to education was utilized.

Method: Physicians and residents were educated as to proper dictation techniques, and templates were introduced. Secondly, referring physicians were also educated on the proper mechanism for ordering studies. The faculty and business manager developed a copyrighted radiology order form to include common protocols for ordering, studies, precertifications, and diagnosis codes. A more aggressive appeals process was devised.

Materials: Copies of templates were added to our dictation system to be utilized by faculty and residents. Examples of denied payments were reviewed in a PowerPoint presentation at noon conferences. Faculty and resident dictations were reviewed for areas of improvement, and feedback was given. Denials data from 2009 and 2010 were compiled and compared.

RESULTS: Denials were divided into four categories: *(a)* lack of precertification, *(b)* lack of medical necessity, *(c)* lack of timely filing, and *(d)* others. The main reasons for denying payment were analyzed, and 2009 data were compared to the 2010 data obtained after education of residents, faculty, and referring physicians. There was a 53% decrease in denials. The category with the most improvement was denials for medical necessity. This decrease was due to improved documentation of the indication for exam, as well as description of exam performed. The education of the referring physicians to provide appropriate signs and symptoms was important. The category where the least improvement was noted was timely filing of claims, which was a very small number. By dictating and signing out reports in a timely fashion, this number was decreased.

CONCLUSION: Education of faculty, residents, and referring physicians can reduce insurance denials.

(R-29) Tuesday • 7:00 AM
Female Radiologists: Pregnancy Policies and Perceptions

Madelene C. Lewis, MD, *Medical University of South Carolina, Charleston, SC*; William J. Rieter, PhD; Leonie Gordon, MBChB *(lewism@musc.edu)*

PURPOSE: The number of women entering diagnostic radiology remains discrepantly low compared to the national average of female medical students. Women usually enter residency during their childbearing years, and radiation safety during pregnancy may be one reason why women are hesitant in choosing radiology as a profession.

METHOD AND MATERIALS: An anonymous electronic survey was e-mailed to active members of the American Association for Women Radiologists (AAWR). Data concerning birth trends, assisted reproduction, policies, and perceptions were analyzed.

RESULTS: A total of 1128 female diagnostic radiologists and radiation oncologists received the online survey, with 280 respondents yielding a response rate of 25%. Of the respondents, 64% (180/280) had biologic children during or after radiology residency. The average age of delivery for the first child was 31.2 years (SD, 3.1), nearly 6 years older than the national average. Assisted reproductive technology utilization was 10 times more likely. Less than half (47%) of respondents were provided a written pregnancy policy. Only 33% of respondents received counseling about radiation exposure during pregnancy. Fluoroscopy and interventional radiology times were restricted by 66% and 72% of respondents, respectively. A maternal lead apron was not available to 64% of respondents. Approximately half of respondents (55%) wore a second dosimeter badge during pregnancy. Respondents were split over concerns about occupational radiation exposure to the fetus, with 52% concerned, 47% with no concerns, and 1% unsure. A total of 65% of respondents would choose to have the same number of children: 69% at same point in career, 28% earlier, and 3% later. Respondents' experiences with co-workers' attitudes were 51% positive, 34% negative, and 15% neutral.

CONCLUSION: Our results suggest that improvements can be made in the formation of written pregnancy policies, radiation safety counseling, and support for pregnant radiologists and radiation oncologists. These improvements will likely make radiology a more attractive field for female medical students.

> **AUR Trainee Prize: 3rd Place**

(R-30) Wednesday • 7:00 AM
Fluoroscopy: An Often Overlooked Source of Radiation—The Effect That Level of Training Has on Patient Fluoroscopic Radiation Dosage, Revisited

Ted Chang, MD, *University of Tennessee Medical Center-Knoxville, Knoxville, TN*; Josue Medina, MD; Jacob K. Pirkle, MD, PharmD; Steven Knight, MD; Kathleen T. Hudson, MD; Ray Higginbotham, MD *(tchang@mc.utmck.edu)*

PURPOSE: Fluoroscopy is commonly utilized for radiological studies, yet it imparts a relatively high radiation dose when compared to other modalities. This study will attempt to answer the following three questions: *(a)* Does level of training significantly affect fluoroscopy times and, thus, patient dosage? *(b)* Is a significant decrease in fluoroscopy times seen following initial training during the PGY-2 year? *(c)* 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 upon fluoroscopy times and patient dosage at a 581-bed teaching hospital. An additional 3 years of data were compiled, for a total of 2964 fluoroscopic exams. Values for patient radiation dose-area product (DAP) and fluoroscopy 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: Data indicate that for most procedures, there was a reduction in the total patient DAP 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 DAP 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.

CONCLUSION: The increased power of including 3 more years of data shows statistically significant differences in radiation dosage and fluoroscopy procedure time imparted to patients based upon level of training. Overall dosages at this hospital were slightly higher than published national and international averages for patient dosage. Reasons for higher examination times and radiation dosage are discussed, with suggestions for lowering patient radiation exposure, in compliance with the ALARA principle.

(R-36) Wednesday • 7:00 AM
Endovascular Management of Epistaxis

Leena Tekchandani, MD, *Winthrop-University Hospital, Mineola, NY*; A. Orlando Ortiz, MD, MBA★ *(ltekchandani@winthrop.org)*

PURPOSE: The purpose of this study was to discuss the role of endovascular embolization in the management of intractable epistaxis.

METHOD AND MATERIALS: This study is a retrospective review of urgent and emergent cases in which all patients presented with epistaxis refractory to conservative management and occlusive nasal packing. The imaging records of 20 patients were reviewed. The etiologies for the epistaxis were recorded. Endovascular therapy was performed by an experienced interventional neuroradiologist (A.O.O.) utilizing the Seldinger transfemoral technique, coaxial catheter technique with a 3-French microcatheter, road-mapping angiographic technique, and embolic materials (polyvinyl alcohol microparticles 150–250 μm or 250–355 μm in size and 2-, 3-, or 5-mm microcoils). Endovascular treatment efficacy was reviewed in each case.

RESULTS: A total of 20 cases were reviewed (16 male, 4 female), with an age range of 10–85 years (mean, 49.0 years). These cases included 10 patients with idiopathic epistaxis, two patients with trauma, two patients who were postsurgical cases, and six patients with tumor. All patients showed a favorable response to endovascular surgery. In those cases where trauma had occurred, the immediate cessation of active hemorrhage was observed. Furthermore, endovascular surgery was helpful in managing patients with idiopathic epistaxis. Lastly, endovascular therapy facilitated the surgical resection of nasal/paranasal masses. No complications were encountered in this group of patients.

CONCLUSION: Endovascular embolization is an excellent technique for managing cases of refractory epistaxis.

(R-38) Wednesday • 7:00 AM
Multiple Myeloma Lesion Detection with Whole-Body CT vs Radiographic Skeletal Survey

FDA

Kelechi Princewill, MD, *University of Maryland, Baltimore, MD*; Sampson Kyere, MD, PhD; Michael E. Mulligan, MD; Omer A. Awan, MD

PURPOSE: Detection of osteolytic lesions for multiple myeloma (MM) staging in the United States has traditionally relied on radiographic skeletal survey (RSS). While RSS is capable of detecting obvious lesions in the appendicular skeleton and skull, there is potential loss of diagnostic accuracy in detecting lesions in the axial skeleton. Whole-body CT (WBCT) is currently used in Europe, where studies have shown it to be superior for detecting MM lesions, compared to SS. The aim of this United States–based study was to compare the diagnostic accuracy of WBCT vs RSS in detecting MM lesions.

METHOD AND MATERIALS: A retrospective review of 300 patients (2004–2011) with MM was conducted. Study included patients who were simultaneously evaluated with RSS and PET/CT scans (<3 months apart) as part of either initial staging and/or surveillance. Only low-dose WBCT images obtained for PET/CT were used for comparison. RSS comparison included the skull, spine, sternum, flat bones (clavicle, scapula, and pelvis), and proximal long bones. Two radiologists independently assessed each imaging modality and recorded lytic lesions from the seven anatomical areas detailed above.

RESULTS: Fifty-one patients (mean age, 56 years) were selected. Average time interval between RSS and WBCT was 26 days. Total number of lesions detected with WBCT was 968 vs 248 for RSS ($P < .001$). Nine

of the 51 patients (18%) had no lesions on either WBCT or RSS. Of the remaining 42 patients, 39 had more lesions on WBCT than by RSS. The number of lesions detected by WBCT would have resulted in upstaging of disease in 31 cases (61%). Eight of these 31 cases had osteolytic lesions on WBCT that were missed on RSS. Overall, 13 patients would have been upstaged from stage I to II, nine patients from stage I to III, and nine patients from stage II to III based on additional lesions detected on WBCT when compared to RSS.

CONCLUSION: WBCT is superior to RSS for detecting osteolytic lesions of MM. WBCT is especially useful for detecting lesions in the spine, sternum, ribs, flat bones, and long bones, compared to RSS. Thirty-one patients (61%) with MM would have been upstaged to a higher disease stage based on either lesions completely missed on RSS or detection of additional osteolytic lesions with WBCT.

(R-39) Tuesday ● 7:00 AM
3-T MR Imaging of Cartilage with Three-dimensional Dual-Echo Steady-State Sequence

Rashmi S. Thakkar, MBBS, MD, *Johns Hopkins School of Medicine, Baltimore, MD*; Aaron J. Flammang, MBA, RT; Avneesh Chhabra, MD★; Abraham Padua, RT★; John A. Carrino, MD, MPH★ *(rthakka4@jhmi.edu)*

Background Information: Magnetic resonance (MR) imaging, with its excellent soft-tissue contrast, is currently the best imaging technique available for the assessment of articular cartilage. Isotropic high-resolution voxels enable reformatting of images into more convenient planes for viewing. 3-T MR scanners enable one to obtain image data with higher resolution, as well as higher signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR). There have been many methods described to image the cartilage. The conventional spin-echo and turbo spin-echo sequences (T1, T2, and PD with or without fat suppression), as well as the gradient-echo sequences (incoherent GRE sequence, such as FLASH, and coherent or steady-state sequence, such as DESS), have been used. In this article, we describe the use of the dual-echo steady-state (DESS; Siemens, Erlangen, Germany) sequence in imaging of the articular cartilage on 3-T MR scanner.

Educational Goals/Teaching Points: This exhibit presents an organized review of the DESS sequence, with its important scanning parameter and clinical implications. In DESS, two or more gradient echoes are acquired. Each of these groups of echoes is separated by a refocusing pulse, and the combined data from both of these echoes result in higher T2* weighting for high signal in cartilage and synovial fluid. The important parameter that needs to be kept in mind while acquiring a DESS sequence is the flip angle (FA), which will be discussed.

Imaging Technique: The dual-echo steady-state (DESS) sequence is a 3D coherent (steady-state) GRE sequence. The DESS sequence has the potential advantage to combine morphological and functional analysis from the same data set with high resolution in a relatively short imaging time. In this exhibit, we will discuss the scanning parameters used while acquiring DESS, its advantages over the 2D fat-suppressed proton-density sequence, and clinical applications in various joints.

Conclusion: Cartilage imaging using the 3D DESS technique has many advantages, including higher SNR, increased cartilage-to-fluid contrast, and isotropic resolution, which helps to reduce partial volume effects.

(R-40) Wednesday ● 7:00 AM
Patellar Instability Measurements on CT and MR Imaging: How Reliable Are They?

Majid Chalian, MD, *Johns Hopkins Hospital, Baltimore, MD*; Rashmi S. Thakkar, MBBS, MD; Filippo Del Grande, MD★; John A. Carrino, MD, MPH★; John Eng, MD; Avneesh Chhabra, MD★ *(mchalia1@jhmi.edu)*

PURPOSE: Patellar instability is a common problem in young patients, with early diagnosis of patellar malalignment and/or maltracking being important for optimal treatment. The tibial tuberosity–trochlear groove (TTTG) distance is the most common measurement used by surgeons to determine patellar malalignment and guide treatment options. Traditionally, CT imaging is used for calculating TTTG distance; however, due to radiation concerns, MRI would be preferred for this measurement. There is a relative paucity of literature comparing TTTG measurements on CT and MRI and interobserver reliability. The aim of this study was to calculate TTTG, trochlear angle, and trochlear depth on CT and MRI in the same subjects, to assess interobserver and intermethod reliability.

METHOD AND MATERIALS: In 34 CT and MRI scans of knee joints in 34 respective subjects (11 men, 23 women; mean age, 38 ± 19 years), three trained observers assessed the TTTG distance, trochlear angle, and trochlear depth on all of the scans. Intraclass correlation coefficient (ICC) and Bland-Altman plot were used to evaluate interobserver and intermethod reliability.

RESULTS: Excellent interobserver reliability (ICC for MRI = 0.90 [0.83–0.95], with mean difference of 0.26 mm; ICC for CT = 0.89 [0.82–0.94], with mean difference of 0.56 mm) and excellent intermethod reliability (ICC = 0.86 [0.71–0.93], with mean difference of 0.63 mm) were found for all of the quantitative measurements.

CONCLUSION: MRI should be used for the assessment of the patella-femoral malalignment measurements due to the excellent interobserver and intermethod reliability. The respective measurements can be used for larger prospective studies directed toward patellofemoral pain syndromes.

(R-43) Tuesday ● 7:00 AM
Osteochondritis Dissecans: Varied Appearances and Misleading Mimics

Luke R. Scalcione, MD, *Winthrop-University Hospital, Mineola, NY*; Jonathan Flug, MD, MBA; Douglas S. Katz, MD; Karen C. Chen, MD; Jerry R. Dwek, MD; Christine Chung, MD *(luke.scalcione@gmail.com)*

PURPOSE: The purpose of this presentation is to heighten the radiologist's awareness of the various imaging appearances of osteochondritis dissecans (OCD) and some common diagnostic pitfalls.

METHOD AND MATERIALS: Utilizing a case-based approach, the reader will review the imaging findings of osteochondritis dissecans across multiple modalities, including conventional radiography, computed tomography, and magnetic resonance imaging. The appearances of osteochondritis dissecans involving various anatomical locations will be demonstrated (ie, knee, ankle, elbow, shoulder, etc). The exhibit will highlight anatomic-specific diagnostic pitfalls and mimics of osteochondritis dissecans, including variant ossification centers in the posterolateral aspect of the lateral femoral condyle, distal humeral trochlea, and adjacent to the glenoid bare area.

RESULTS: Each case will detail the specific imaging findings of osteochondritis dissecans. Emphasis will be placed on identifying the integrity of the subchondral bone plate, overlying articular cartilage, and subjacent reactive bone marrow changes. The results will be presented by utilizing high-quality conventional radiographs, computed tomographic images, and magnetic resonance images from our institution.

CONCLUSION: Osteochondritis dissecans may have varied imaging appearances on conventional radiographs, CT, or MRI. It is important for the radiologist to be cognizant of these imaging findings and the anatomic-specific diagnostic pitfalls when considering the diagnosis of osteochondritis dissecans.

(R-50) Wednesday ● 7:00 AM
Comparison of Conventional and Novel Metal Artifact Reduction Sequence Strategies at 1.5 T and 3 T to Reduce the Volumes of Total and Bright Metal Artifacts

(FDA)

Raghuram K. Rao, MD, MPH, *University of Texas Medical Branch, Galveston, TX*; Nirav Patel, MD, MBA; Miriam Reichert, MD; Tao Ai, MD *(rkrao@utmb.edu)*

PURPOSE: Our aim was to measure volumes of metal artifact encountered when imaging orthopedic hardware with standard and metal artifact reduction strategies in 1.5-T and 3-T magnetic resonance imaging (MRI) systems. We also focused on comparing high-signal-intensity (bright) artifact on these sequences, as this can mimic pathological lesions.

METHOD AND MATERIALS: Metal artifact reduction techniques, including view angle tilting (VAT) and slice encoding metal artifact correction (SEMAC), were evaluated individually and in conjunction (SEMAC-VAT) and were compared with conventional techniques without artifact reduction strategies (Product). T1, T2, and short-tau inversion-recovery (STIR) images of an orthopedic screw in agarose gel were obtained by using these techniques at 1.5 T and 3 T (Siemens, Germany). By using a workstation platform (GE, United States), the total volume of artifact was calculated for these sequences. The contributing volume of bright artifact was then determined.

RESULTS: Compared to conventional acquisitions (Product), newer techniques (SEMAC, VAT, and SEMAC-VAT) had a reduction in total metal artifact volume. At 1.5 T, the range of total volume of artifact was 3.5–11.7 cc for the artifact-reducing sequences, compared to 19.4–42.9 cc for conventional acquisitions. Range values at 3 T were 10.3–69.2 cc (artifact reduction techniques), compared to 34.6–113.5 cc (Product). At both field strengths, the mean total and mean bright artifact volume followed the trend: SEMAC-VAT < SEMAC < VAT < conventional acquisitions. At 1.5 T, the mean total artifact volumes were 5.9, 7.2, 10.0, and 31.2 cc, and the mean bright artifact volumes were 1.1, 2.0, 2.7, and 4.9 cc, respectively. At 3 T, the mean total volume artifact was similar for artifact-reducing sequences (range, 33.2–37.7 cc), compared to conventional acquisitions (75.9 cc), but the bright artifact volume for SEMAC-VAT (4.5 cc) was lowest. With regard to the pulse sequences, T2 had the least mean total metal artifact volume at both field strengths. Although STIR sequences produced the least bright artifact at 1.5 T, T2 showed lowest levels at 3 T.

CONCLUSION: Our data suggest that regardless of field strength and pulse sequence, SEMAC-VAT reduces the overall volumes of both total artifact and bright artifact.

AUR Trainee Prize: 2nd Place

(R-59) Tuesday ● 7:00 AM
High-Resolution 3-T MR Neurography of Common Peroneal Nerve Neuropathy

Majid Chalian, MD, *Johns Hopkins Hospital, Baltimore, MD*; Pearlene Lee; Eric H. Williams; Allan Belzberg; John Eng, MD; John A. Carrino, MD, MPH★; et al *(mchalia1@jhmi.edu)*

PURPOSE: The purpose was to examine the diagnostic accuracy of semi-quantitative and qualitative MR neurography (MRN) criteria in common peroneal nerve (CPN) neuropathy.

METHOD AND MATERIALS: Institutional review board approval was obtained with waiver of informed consent for this HIPAA-compliant retrospective study. A review of 28 knees in 28 subjects (12 males, 16 females; age range, 13–84 years; mean age, 42 ± 20 years) who had undergone MR neurography of the knee was performed. Thirteen patients who had a final diagnosis of CPN neuropathy were classified as cases, and 15 patients who lacked a final diagnosis of CPN neuropathy were classified as controls. Morphological characteristics of the CPN, including nerve T2 signal intensity, nerve size, nerve course, fascicle morphology, regional muscle edema, and fatty infiltration, and an overall assessment of the CPN as being normal or abnormal were evaluated by two independent radiologists blinded to the clinical history. Overall sensitivity, specificity, and accuracy compared against our reference standards were expressed as percentages. Interobserver agreement was assessed by using linear weighted κ statistics.

RESULTS: CPN T2 signal abnormality had the highest sensitivity (77%) in identifying CPN neuropathy. Except for T2 signal abnormality, overall specificity for the nerve morphological parameters and for muscle denervation change assessed was fairly high, ranging from 73% to 100%. The consensus accuracy ranged from 68% to 79% for the morphological characteristics assessed. The interobserver reproducibility was very good (κ = 0.90–0.91) for assessment of regional muscle denervation changes and was moderate (κ = 0.46–0.59) for morphological CPN characteristics.

CONCLUSION: MRN is a useful modality in supplementing the diagnosis of common peroneal neuropathy. Utilizing predefined classification criteria helps standardize the morphological criteria of CPN neuropathy diagnosis.

(R-62) Wednesday ● 7:00 AM
Effects on Image Quality from Increasing Noise in Low-Dose CT Perfusion Imaging

Jennifer Shih, MD, *Cornell New York-Presbyterian Hospital, New York, NY*; YuZhe Liu; Charles Herrmann; Andrew Hoelscher; Ashish Rao; Pina C. Sanelli, MD, MPH★; et al *(jes9121@nyp.org)*

PURPOSE: The purpose was to determine the effects of increased noise on image quality in low-dose CT perfusion (CTP) imaging.

METHOD AND MATERIALS: The acquired CTP images from 20 patients with subarachnoid hemorrhage were included as the reference data set performed per standard protocol (190 mA, 80 kVp, and 2.0-cm scanning volume consisting of four slices). An algorithm for introducing spectral noise was applied to these CTP images to generate noise-simulated data sets representing five levels of tube current (182, 154, 132, 75, and 17 mA). Standardized methods were used to postprocess all CTP data sets into cerebral blood flow (CBF), cerebral blood volume (CBV), and mean transit time (MTT) maps. A software program was developed to randomly display a noise-simulated CTP map with its reference map for comparison. Six radiologists determined a quality score using a Likert grading scale (grade 1 as highest quality). For each CTP map, Spearman rank correlation coefficient (SRC) determined the relationship between quality grade and noise level. Interobserver agreement was calculated by prevalence-adjusted bias-adjusted kappa (PABAK) values.

RESULTS: A total of 1200 maps were generated: 400 CBF, 400 CBV, and 400 MTT. A total of 7200 quality scores were collected from the six observers. For CBF, the frequency of grade 1 scores for noise levels 1, 2, 3, 4, and 5 was 89%, 85%, 88%, 80%, and 43%, respectively (SRC = –0.34; $P < .0001$). For CBV, the frequency of grade 1 was 95%, 94%, 94%, 94%, and 52% (SRC = –0.35; $P < .0001$). For MTT, the frequency of grade 1 was 75%, 74%, 73%, 60%, and 17.5% (SRC = –0.44; $P < .0001$). The mean PABAK values for noise levels 1, 2, 3, 4, and 5 for CBF are 0.95, 0.98, 0.98, 0.95, and 0.52; for CBV are 1, 1, 1, 1, and 0.83; and for MTT are 0.83, 0.86, 0.88, 0.74, and 0.05, respectively.

CONCLUSION: A statistically significant worsening in the image quality of CTP maps at the highest noise level (estimated 17 mA) is promising to define a lower limit mA for low-dose CTP imaging. Interobserver agreement was also worse at this level, potentially leading to increased variability in interpretations. This preliminary work reveals that an estimated threshold tube current of 75 mA and above can potentially be used for low-dose CTP imaging to reduce radiation exposure while maintaining image quality.

(R-63) Tuesday ● 7:00 AM
Is There a Need to Increase Neuroradiology MR Imaging Training in the 1st Year of Radiology Residency?

Nicholas McDonald, MD, *University of Cincinnati Medical Center, Cincinnati, OH*; Mary Gaskill-Shipley; Achala S. Vagal, MD

PURPOSE: Although there is a growing trend towards 24/7 coverage by staff radiologists, radiology residents continue to provide preliminary interpretations of overnight studies at most academic medical centers. Interpretations may be challenging, especially for advanced imaging modalities such as MRI, where there may be inadequate training in the initial residency year. We utilized a long-term resident quality assurance (QA) process at our institution to analyze trends of overnight neuroradiology MRI interpretations and to identify if the resident level of training affected the discrepancy rate.

METHOD AND MATERIALS: At our institution, emergent neuroradiology MRI studies are prospectively interpreted by radiology residents from 5:00 PM until 7:00 AM and reviewed the following morning by staff neuroradiologists. Any discrepancies are documented in the final dictation and communicated to the emergency department or ordering in-house physician. The QA data from preliminary resident interpretations from January 2005 to August 2011 were retrospectively reviewed.

RESULTS: There was an increase of 900% in emergent overnight neuroradiology MRI studies ordered between 2005 and 2010. This obviously reflects the general trend of increasing utilization of imaging studies, particularly in the emergency department. There were a total of 48 documented discrepancies (major and minor) during this time period. Of the 48 discrepancies, 25 (52%) were originally interpreted by 2nd-year residents, 14 (29%) by 3rd-year residents, and eight (17%) by 4th-year residents. One discrepancy was originally interpreted by a neuroradiology fellow.

CONCLUSION: Although the QA process is predominantly used for tracking misinterpretations of resident overnight readings, important lessons can be learned. The 2nd-year residents had the most misinterpretations. This may be related to decreased experience and/or increased call frequency among more junior residents. Traditionally, 1st-year residents have limited exposure to MRI. Given the increasing utilization and expectation of accurate overnight MRI interpretations, however, academic institutions may perceive a need to increase MRI training in the 1st year of residency to prepare residents for future call.

★ Faculty financial disclosures are located in the Faculty Index.

RESEARCH POSTERS

(R-65) Tuesday ● 7:00 AM
Intraventricular Masses: A Review and Discussion

Jacob K. Pirkle, MD, PharmD, *University of Tennessee Medical Center-Knoxville, Knoxville, TN*; Thomas D. Santoro, MD; James W. Boyd, MD *(jpirkle@mc.utmck.edu)*

PURPOSE: The purpose of this poster is to provide the audience with a relatively comprehensive overview of intraventricular masses and to equip the viewer with an adequate differential diagnosis based upon the imaging appearance and location of intraventricular masses.

METHOD AND MATERIALS: A review of intraventricular masses will be provided in pictorial poster format, providing the reader with information to be able to develop an adequate differential diagnosis of intraventricular masses based upon their location, imaging appearance, and patient age. Cases obtained at our institution will be provided as representative examples.

RESULTS: Intraventricular masses are relatively rare, comprising approximately 10% of all CNS neoplasms. As with any lesion in radiology, a few key pieces of information can help the interpreter either come to a correct diagnosis or be able to give an adequate differential diagnosis, which will include the correct diagnosis the majority of the time. In the case of intraventricular masses, the first key piece of information needed is the location of the mass. This, along with patient age and imaging appearance, can significantly narrow the differential considerations for an intraventricular mass. In the lateral ventricle, the most common mass among pediatric patients and adults is a choroid plexus cyst. Additional lateral ventricular masses in children include choroid plexus tumor, astrocytoma, subependymal giant cell astrocytoma, PNET, and ependymoma. Further considerations in adults include meningioma, central neurocytoma, subependymoma, metastatic disease, and lymphoma. Third ventricular masses include colloid cyst, germ cell tumor, craniopharyngioma, tuber cinereum hamartoma, teratoma, and glioma. Fourth ventricular masses include medulloblastoma, ependymoma, pilocytic astrocytoma, brainstem glioma, epidermoid, and dermoid.

CONCLUSION: Intraventricular masses are relatively rare, but a correct diagnosis or an adequate differential diagnosis can usually be provided based upon location, patient age, and imaging features. This pictorial review poster presentation provides the reader with an adequate knowledge of these lesions.

(R-66) Wednesday ● 7:00 AM
Labeling Ambiguous Lumbosacral Transitional Vertebrae on MR Images: Does the Celiac Artery Origin Reliably Identify the Junction of Rib-bearing and Non–Rib-bearing Vertebrae?

Lance A. Warren, MD, *University of Tennessee-Knoxville, Knoxville, TN*; Ted Chang, MD; Paul D. Campbell, Jr, MD; John Snidow, MD *(lwarren@mc.utmck.edu)*

PURPOSE: To decrease the risk of "wrong site" intervention, it is essential to accurately identify vertebral segments on preprocedure MR imaging, including clear delineation of the relationship of the pathology to the junction of rib-bearing and non–rib-bearing vertebrae (RNJ). Unfortunately, the RNJ is often not clearly definable on lumbar MR images, and consequently, a landmark from which its position could be inferred in such cases is desirable. Our study was designed to determine if the celiac artery origin on sagittal MR images might be useful as a reliable predictor of the RNJ when ambiguity is introduced by the presence of lumbosacral transitional vertebrae (LSTVs).

METHOD AND MATERIALS: Full spinal column CT with multiplanar reconstructions was chosen as a gold standard for vertebral body labeling. The CT images from 50 consecutive patients who underwent full spinal column CT imaging were retrospectively reviewed to determine the relationship of the celiac artery origin to the RNJ. To coincide with the central AP fluoroscopic beam for a patient in the prone position, a line perpendicular to the CT tabletop was projected through the superior margin of the celiac artery origin. The point where this line intersected the posterior longitudinal ligament relative to the pedicles was tabulated.

RESULTS: The perpendicular line intersected the posterior longitudinal ligament between the superior cortical margin of the pedicle for the most caudal rib-bearing vertebra and the pedicle for the subjacent non–rib-bearing vertebra, correctly marking the RNJ in 46 of 50 cases (92%). The

method also successfully localized the RNJ in the single patient having only four lumbar vertebrae. However, of the four cases where the method failed, two failures occurred in the five patients having O'Driscoll type 4 LSTV, and the other two failures occurred in patients having intermediates of type 2 and 3.

CONCLUSION: Despite reasonable overall sensitivity in predicting the RNJ, given that the method failed in 40% of patients with O'Driscoll type 4 LSTV, its potential utility is in doubt. Consequently, further investigation should focus on other anatomic landmarks and methods for localization.

(R-69) Tuesday ● 7:00 AM
Ruptured Intracranial Dermoid Tumor: A Radiographic, Pathologic, and Surgical Discussion

Michael J. Ray, MD, *Baylor University Medical Center, Dallas, TX*; Kennith F. Layton, MD; Michael J. Opatowsky, MD *(mjordan.ray@gmail.com)*

PURPOSE: Rupture of an intracranial dermoid tumor is a rare occurrence, with considerable associated morbidity and potential mortality. We present a case of intracranial rupture of a dermoid tumor with consequent dissemination of subarachnoid fat droplets resulting in acute aseptic chemical meningitis. Radiographic findings, surgical treatment, and pathologic features are described.

METHOD AND MATERIALS: A 46-year-old man, without significant past medical history, presented for the evaluation of constant unrelenting headaches of 1 month's duration. The headaches had a waxing and waning course, with sporadic episodes of photophobia. An initial CT scan demonstrated a 2.4-cm-diameter extraaxial fat-containing mass with scattered intralesional calcifications centered near the anterior clinoid process. Scattered fat-containing droplets were disseminated throughout the subarachnoid space. The patient was taken to the operating room, where a craniotomy flap was elevated for exposure. A clear fat plane existed between the tumor and the brain parenchyma, and the borders were separated. The tumor was excised. Pathologic evaluation of the submitted tissue confirmed the diagnosis of a dermoid cystic tumor.

RESULTS: Imaging features of intracranial dermoid tumors are virtually pathognomonic. These lesions will have internal density characteristics consistent with fat, although density values greater than fat may be encountered, depending on the nature of an individual tumor's contents. When a dermoid tumor ruptures, fat droplets that are hypodense on CT or T1 hyperintense on MRI may be seen scattered and floating within the nondependent portions of the ventricular system and/or subarachnoid space. This is considered a classic imaging feature of these lesions.

CONCLUSION: Although the imaging appearance of dermoid tumors is characteristic, there are several other intracranial lesions that must be considered in the differential diagnosis, such as epidermoids, teratomas, lipomas, craniopharyngiomas, and, occasionally, arachnoid cysts. A review of all available CT and MR images often allows the radiologist to offer an accurate preoperative diagnosis. Patients typically do well after surgical intervention.

(R-70) Wednesday ● 7:00 AM
Comparison of Visualization of a Cochlear Implant with a Biplane Flat-Panel Detector vs Multidetector CT

Benson Tran, MD, *University of Texas Medical Branch, Galveston, TX*; Frank L. Goerner, PhD

PURPOSE: The goal was to compare the image quality obtained in the temporal bone region with a cochlear implant in place by using biplane flat-panel CT technology (DynaCT) vs 64-slice multidetector CT.

METHOD AND MATERIALS: The metallic electrode from a cochlear implant (Nucleus 24) was inserted near the region of the temporal bone in an ABR-approved head phantom. Images acquired with DynaCT and 64-slice multidetector CT were presented unlabeled to a board-certified neurointerventional radiologist and compared with regard to the degree of streak artifact. A biplane flat-panel detector (DynaCT; Siemens) was used. A DynaCT acquisition was obtained by using the following parameters: 10-second rotation; 0.4° increment; 217° total angle; 83 kVp; 244 mAs; and slice thickness, 1 mm. A CT scanner (GE LightSpeed VCT 64) was used with the temporal bone protocol: 120 kVp; 250 mAs; and slice thickness, 1 mm. The contrast resolution of the biplane flat-panel detector was compared to that of multidetector CT with the help of an ACR CT accreditation

phantom (Gammex 464). The module 4 portion of the phantom was used to assess spatial resolution. The signal-to-noise ratio for the biplane flat-panel detector and for multidetector CT was calculated by using module 2 of the ACR phantom.

RESULTS: The images from both modalities were reviewed, and the degree of image degradation from streak artifact was assessed. Images obtained from the biplane flat-panel detector contained considerably less streak artifact from the cochlear implant than images from 64-slice MDCT. The signal-to-noise ratio of the biplane flat-panel detector was 1.3, which was higher than that of multidetector CT, which was 1.2. Also, the spatial resolution of the biplane flat-panel detector was 12 lp/cm, more than the 7-lp/cm spatial resolution of multidetector CT.

CONCLUSION: Advantages of flat-panel detector CT over multidetector CT are related to the unique design of the detectors and their ability to be used in various functions, such as radiography, CT, angiography, and real-time fluoroscopy. Given the higher intrinsic spatial resolution, increased signal-to-noise ratio, and the decreased streak artifact in comparison to MDCT, fields such as cardiology, interventional radiology, neurosurgery, and otolaryngology have much to gain in the use of flat-panel detector technology.

(R-71) Tuesday • 7:00 AM
Orbital and Intracranial Effects of Microgravity: 3-T MR Imaging Findings

Larry A. Kramer, MD, *University of Texas Medical School, Houston, TX*; Khadr M. Hasan, PhD *(larry.a.kramer@uth.tmc.edu)*

Visual acuity changes in astronauts is a newly recognized phenomenon that has become more apparent with longer excursions into an environment of microgravity afforded by the international space station. On clinical exam, changes in visual acuity are associated with choroidal folds, retinal nerve fiber layer thickening, hyperopic shifts, cotton wool spots, and optic disc edema. To further characterize findings seen on neuro-ophthalmologic exam and to identify potential copathologies, high-resolution MR imaging of orbits and brain at 3 T has been utilized in a subset of astronauts. The goal of this exhibit is to present the orbital and intracranial imaging findings in a population of astronauts exposed to microgravity on both long- and short-duration missions. We will describe in detail the MR imaging anatomy of the normal and abnormal optic disc, retrolaminar optic nerve, optic nerve sheath, posterior sclera, and pituitary gland. The differential diagnosis of the constellation of imaging findings will be compared to the known pituitary and intraorbital effects of intracranial hypertension as supported by current literature. The relationship of intracranial hypertension to optic nerve sheath distention is discussed. Some astronauts exposed to microgravity demonstrate distention of the optic nerve sheath, tortuosity of the optic nerve sheath with a kink, posterior globe flattening, optic disc protrusion, and empty sella or partial concavity of the pituitary gland with posterior stalk displacement. With increasing mission duration, an increasing number and combination of these abnormalities are detected. The 3D MR imaging technique to measure optic nerve sheath diameter will be described. Although the exact mechanism is unknown, prolonged exposure to an environment of microgravity is associated with morphological changes of the globe, optic nerve, optic nerve sheath, and pituitary gland similar to those of idiopathic intracranial hypertension in a subset of astronauts. Further work is needed to determine those astronauts most at risk and to mitigate clinical symptomatology.

(R-74) Tuesday • 7:00 AM
Posttherapeutic and Postoperative Manifestations of Breast Cancer on Thoracic CT: Correlation with Breast Multimodality Imaging

Zeynep Yilmaz, MD, BS, *University of Michigan, Ann Arbor, MI*; Colleen Neal, MD; Katherine A. Klein, MD; Mitra Noroozian, MD; Baskaran Sundaram, MBBS; Jadranka Stojanovska Nojkova, MD★

Purpose/Aim: 1. Understand the wide variety of breast cancer surgeries and interventions, as well as changes in anatomy after breast cancer treatment. 2. Review clinical and imaging features of postoperative and posttherapeutic changes of breast cancer on thoracic computed tomography (CT) and their significance. 3. Correlate thoracic CT imaging findings after breast cancer treatment with breast multimodality imaging (mammography, ultrasound, MRI, and PET).

Content Organization: Postsurgical imaging appearance of the chest wall depends on the surgical method used (radical mastectomy, modified radical mastectomy, breast-conserving surgery, breast reconstruction). Complications secondary to surgery include seroma, infection, hemorrhage, flap necrosis, lymphedema, and axillary contracture. The spectrum of postoperative changes of breast cancer (types of surgical approaches, surgery-related complications), postradiation (radiation-related complications) changes, local and regional recurrence. and metastases on thoracic CT will be presented as a series of clinical cases. The following aspects will be discussed: *(a)* clinical features, treatment, and prognosis of breast cancer; *(b)* CT imaging findings in breast cancer patients and correlation with breast multimodality imaging; and *(c)* clinical significance and alternative techniques.

Conclusion/Summary: Breast cancer is a leading cause of cancer-related death in women. Thoracic CT is an important tool commonly used in breast cancer patients for surveillance. This exhibit will enable the cardio-thoracic radiologists to understand the common posttherapeutic changes in the breast, as well show examples of tumor recurrence.

(R-75) Tuesday • 7:00 AM
Screening Mammography Performance Improvement Initiative

Patricia Miller, *Henry Ford Hospital, Detroit, MI*; Brooke Wessman

PURPOSE: The purpose was to demonstrate a mammography department's Lean process journey to improve the turnaround time for a screening mammogram study and the delivery of patient results by over 100% through process redesign and the elimination of waste.

METHOD AND MATERIALS: As the department had been recently upgraded to 100% digital mammography, it was felt there was opportunity to improve turnaround time and evaluate the feasibility of offering same-day screening mammography results. The current process had a minimum time for a woman to receive screening mammogram results of 4 days and a maximum time of 30 days. The team outlined the following issues with the current state process: Comparison to prior film-screen mammograms necessitated use of the mammography jacket, which was used to drive the interpretation process. Patient history forms were recorded on paper, and delivery of the form to the interpretation site was also a cause of delay in interpretation. Lastly, creation and mailing of the patient letter were found to cause delay in patients receiving timely results. The team identified two goals: *(a)* patients to receive screening mammogram results by mail within 48 hours and *(b)* patients who desired same-day results would receive verbal results at the time of appointment.

RESULTS: The team completed the following: *(a)* eliminated the use of jackets for screening mammogram studies and improved turnaround time from 1.5 days to just over 1.5 hours, *(b)* created online filters and patient information plug-ins for radiologists to view screening mammograms when they were completed, *(c)* eliminated paper history, *(d)* improved the letter batching process to five times per day, and *(e)* created dedicated same-day result appointment slots for patients who wanted their results prior to leaving the clinic.

CONCLUSION: The elimination of jackets and paper improved the turnaround time at many sites by days. There was a 600% improvement in the percent of studies that were finalized within 8 hours and over a 150% improvement in the percent of studies that were finalized within 48 hours. Patients were offered same-day results if requested, and most results were available to patients within 48 hours of completion of the mammogram.

RESEARCH POSTERS

AUR 2012 Education Poster Abstracts

Education posters are located in Grand Oaks Ballroom J. Each poster will be presented by its author during
AMA PRA Category 1 Credit™ poster sessions scheduled for 7:00–8:15 AM, Tuesday and Wednesday.
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, fellows, or 1st-year fellows) are noted in **burnt orange**.

(E-03) Tuesday ● 7:00 AM
Multimodality Imaging of Complications of Liver Transplantation: What a Radiologist Should Know

Vivek Gowdra Halappa, MD, *Johns Hopkins Hospital, Baltimore, MD*; Celia P. Corona-Villalobos, MD; Ihab R. Kamel, MD, PhD★ (*ikamel@jhmi.edu*)

LEARNING OBJECTIVES: 1. Identify types of liver transplantation and indications. 2. Describe the normal vascular surgical anastomoses. 3. Describe the major complications of liver transplantation, including *(a)* vascular, *(b)* biliary, *(c)* fluid collections, and *(d)* rejection.

CONTENT DESCRIPTION: Postoperative liver transplant imaging involves multiple imaging modalities (US, CT, MR). It is important to know about common surgical techniques, possible complications, and advantages and disadvantages of various imaging modalities in imaging post–liver transplantation complications.

Content Organization: I. Indications for and types of liver transplantation. II. Common surgical techniques. III. Evaluation of complications with various imaging modalities, including ultrasound, CT/CTA, and MRI/MRA. IV. Evaluation of liver parenchyma and vascular and biliary anatomy. V. Complications. A. Vascular (stenosis, occlusion, fistula, and pseudoaneurysm formation). B. Biliary (strictures, stones, and bile leaks). C. Fluid collections. D. Rejection.

Conclusion: Imaging postoperative liver transplant patients involves a multimodality approach using ultrasound, CT, and MRI. It is important to understand potential postoperative complications and the pros and cons of each imaging modality, which can aid in proper diagnosis.

(E-04) Wednesday ● 7:00 AM
The Perplexing CT of the Acute Abdomen: A Potpourri, with Pitfalls and Pearls from Recent Experience

Douglas S. Katz, MD, *Winthrop-University Hospital, Mineola, NY*; Joseph P. Mazzie, DO; Kristen Fruauff; Brian Buonocore, MD (*dkatz@winthrop.org*)

LEARNING OBJECTIVES: Even for experienced radiologists, the acute abdomen may present a substantial challenge on CT examinations. Patients have nonspecific clinical presentations, and the burden is on the radiologist to diagnose even esoteric disorders with a high degree of specificity. Ten recent difficult CT cases of acute abdomen will be shown, with a corresponding brief literature review.

CONTENT DESCRIPTION: Ten recent cases of acute abdomen from a single institution, with a challenging cause of the acute abdomen demonstrated on CT, will be shown, with corresponding brief discussions and with a literature review and teaching points. Cases will include necrotizing cholecystitis in a young child, ACE inhibitor–related small bowel angioedema, dropped gallstone and appendiceal abscesses with associated actinomycosis infection, small bowel diverticulitis, tumor presenting as renal colic on noncontrast CT including metastatic germ cell tumor related to an undescended testicle, free air related to gas-forming hepatic abscesses in a diabetic patient, IVC thrombosis on noncontrast CT, and the initial presentation of ruptured/hemorrhagic neoplasms. In summary, patients present with nonspecific signs and symptoms of an acute abdomen, and the radiologist is often provided with little or no additional history when interpreting such CT examinations. The possible diagnoses are myriad and may challenge even the most experienced cross-sectional radiologist. The burden on the radiologist is to diagnose even very esoteric disorders with which she or he may not be familiar or even be aware of.

(E-05) Tuesday ● 7:00 AM
"No Guts, No Glory!": Utilizing Balloon Models to Demonstrate Common and Uncommon Gastrointestinal Surgical Procedures—A Novel Resident Teaching Tool

Jay Acharya, BA, MD, *Westchester Medical Center, Valhalla, NY*; Patricia Chang, BS, MD; Perry Gerard, MD; Zvi Lefkovitz, MD

LEARNING OBJECTIVES: 1. Illustrate an array of common and uncommon gastrointestinal surgical procedures seen in radiology. 2. Demonstrate, utilizing unique 3D balloon models, the basic purpose of the procedures and the relevant anatomy. 3. Relate the final appearance of the procedures to what is seen on different imaging modalities.

CONTENT DESCRIPTION: The evaluation of an imaging study of a postoperative patient with minimal clinical information can be difficult, especially if compounded by unfamiliarity with the given procedure, its techniques, and its applications. Correlation of postsurgical anatomic changes with their appearance on various imaging modalities is paramount to correct interpretation of the imaging studies. The relevant anatomy associated with gastrointestinal surgical procedures can be uniquely rendered in a 3D balloon model. We demonstrate a new simple technique using simple balloon models to teach residents the concepts of common and uncommon gastrointestinal surgical procedures that they may encounter. Outline of GI surgical procedures: I. Billroth II. II. Whipple procedure. III. Kasai procedure. IV. Ladd procedure. V. Intestinal stomas. VI. Ileoanal pull-through. VII. Partial colectomy with Hartmann's pouch. VIII. Abdominoperineal resection of the rectum. IX. Lower anterior resection of the rectum.

(E-06) Wednesday ● 7:00 AM
Characteristic Imaging Features of Small Bowel Neoplasms in MR Enteroclysis

Bahar Mansoori, MD, *University Hospitals Case Medical Center, Case Western Reserve University, Cleveland, OH*; Karin A. Herrmann, MD; Pablo R. Ros, MD, MPH★ (*Bahar.Mansoori@UHhospitals.org*)

LEARNING OBJECTIVES: 1. Review the clinical presentations of small bowel tumors (SBTs). 2. Review characteristic imaging features of the different types of SBTs in MR enteroclysis (MRE). 3. Describe the accuracy of various diagnostic imaging modalities in the detection of SBT, as compared to MRE. 4. Identify the basic principles of MRE technique and its advantages over MR enterography in diagnosing SBTs.

CONTENT DESCRIPTION: The present exhibit provides an overview of the clinical presentation and typical imaging morphology of SBTs at MRE and discusses MRE accuracy as compared to other imaging modalities. The exhibit consists of the following sections: I. Introduction. II. Review the clinical presentation of SBTs. III. Describe the basic technique of MRE. IV. Illustrate and describe the typical imaging appearance and morphology of various SBTs. V. Discuss MRE limitations and pitfalls.

(E-07) Tuesday ● 7:00 AM
Application of MR Enterography as a Nonionizing Radiation Means to Follow Young Patients with Crohn's Disease

Kyungmin Shin, MD, *University of Virginia Health System, Charlottesville, VA*; Drew Lambert, MD

LEARNING OBJECTIVES: Increasing concern about radiation among patients and referring physicians makes current standard examinations such as small bowel follow-through or CT enterography in the evaluation and follow-up of Crohn's disease less attractive. MR enterography offers a safe ionizing radiation–free means to evaluate the small bowel in young patients who need monitoring and evaluation of complications for Crohn's disease. Here we will: 1. Review the standard protocol for MR enterography at our

institution. 2. Review and compare imaging findings of MR enterography compared to CT enterography and small bowel follow-through. 3. Compare imaging findings of MR enterography with clinical notes to evaluate correlation between the imaging findings and the clinical symptoms.

CONTENT DESCRIPTION: We will first review the imaging protocol at our institution for MR enterography and the key imaging findings of MR enterography in patients with Crohn's disease. Forty-five cases of patients with MR enterography and gastroenterologists' clinic notes from September 2010 to July 2011 were reviewed that demonstrated positive correlation between the imaging findings and the clinical symptoms. This positive correlation suggests that MR enterography is a safe ionizing radiation–free means to follow known Crohn's disease patients to monitor and guide their therapy and detect complications.

(E-08) Wednesday ● 7:00 AM
What Keeps Residents Awake at Night: Pitfalls and Nuances of Sigmoid Diverticular Disease

Dmitriy Akselrod, MD, *University of Vermont Fletcher Allen Healthcare, Burlington, VT*; David P. Keating, MD (*dgakselrod@hotmail.com*)

LEARNING OBJECTIVE: Describe unusual imaging presentations and complications of acute sigmoid diverticulitis, including examples where the underlying disease process is masked by complex sequelae of the primary disease.

CONTENT DESCRIPTION: Although the diagnosis of acute sigmoid diverticulitis is normally made with a high level of confidence, radiologists should be aware of the spectrum of unusual complications of this common condition, to avoid pitfalls in diagnosis. Emphasis will be placed on cross-sectional modalities (CT and MR).

Content Organization: I. Brief review of the pathogenesis and typical findings in diverticulitis. II. Examples of uncommon complications, including fistula to an ovarian dermoid, simulating torsion; perforated diverticulitis with extensive peritoneal and subperitoneal inflammation masking the inciting event; diverticular abscess inciting obstructing small bowel volvulus; fistula to uterus, causing endocavitary abscess; fistula to ovary, simulating ovarian mass; mild diverticulitis causing IMV thrombosis; and giant diverticulum.

(E-09) Tuesday ● 7:00 AM
Hard to Swallow: Odynophagia and the Esophagram in the Emergency Room Setting

Brendan Banyon, *University of Vermont Fletcher Allen Healthcare, Burlington, VT*; Dmitriy Akselrod, MD; Robert D'Agostino, MD (*dgakselrod@hotmail.com*)

LEARNING OBJECTIVES: 1. Recognize the imaging characteristics and differential diagnosis of common and uncommon causes of odynophagia in the ER population. 2. Understand the importance of the clinical history and choice of imaging study in ER patients with a chief complaint of odynophagia. 3. Describe techniques for the fluoroscopic esophagram.

CONTENT DESCRIPTION: Special consideration should be given to patients with acute painful swallowing. With varying causes of odynophagia, a good clinical history and choice of imaging modality and technique can be helpful in making accurate diagnoses and aiding in patient management. Cases will be drawn from the emergency room at the University of Vermont/Fletcher Allen Health Care. All patients presented with a chief complaint of painful swallowing. Using a case-based format, the clinical history and imaging studies will be presented to the learner, with a focus on the use of the fluoroscopic esophagram. A short discussion of techniques used for esophagrams will be provided. Pathologic entities discussed will include candidiasis, pill esophagitis, food impaction, foreign body, giant peptic ulcer, and eosinophilic esophagitis, along with others. Final diagnoses will be supported by radiographic, endoscopic, and pathologic images. Discussion of the differential diagnosis and the pathologic process will conclude each case.

(E-10) Wednesday ● 7:00 AM
Liver Segments: Beyond Couinaud

Timothy Ziemlewicz, MD, *University of Wisconsin, Madison, WI*

LEARNING OBJECTIVES: 1. Define normal portal venous anatomy and common variants. 2. Describe hepatic segmentation based on portal venous supply, a truer representation than classic teaching, which utilizes

the hepatic and portal veins to divide the hepatic segments. 3. More accurately identify and localize hepatic lesions to direct surgeons for segmentectomy.

CONTENT DESCRIPTION: I. Comparison of normal and variant portal venous anatomy utilizing 3D reconstructed images. II. Describe use of vessels-growing software to determine surface anatomy and volume of hepatic segments. III. Outline differences between classical Couinaud segmentation and true segmentation based on portal venous supply. IV. Provide case examples where a hepatic lesion can be accurately localized to a segment by portal venous supply when it appears on the border of two or more segments by Couinaud.

(E-11) Tuesday ● 7:00 AM
Lung Cancer Screening: The Graphic Novel

Stefan Tigges, MD, *Emory Clinic, Atlanta, GA* (*stigges@emory.edu*)

LEARNING OBJECTIVES: 1. Explain the rationale for lung cancer screening. 2. List and define 10 criteria for effective screening. 3. Define pseudodisease, and explain how its presence may spuriously improve the efficacy of lung cancer screening. 4. Define the following terms: lead-time bias, length-time bias, overdiagnosis bias, and stage migration bias. 5. List two lung cancer screening trials, and state whether they were randomized, what the results were, and what the outcome measure was. 6. Define cost-effectiveness.

CONTENT DESCRIPTION: Lung cancer is the leading cancer killer in the United States, and treatment costs are approximately 10 billion dollars a year. The recently published National Lung Screening Trial (NLST) indicates that smokers screened with CT have improved mortality compared with those screened with plain radiography, but the authors of the study caution that "the current NLST data alone are, in our opinion, insufficient to fully inform" the decision to establish lung cancer screening recommendations. Although the rationale for cancer screening is straightforward, there are multiple counterintuitive biases that may influence the impact of a national screening program. This short graphic novel is intended to familiarize readers with the basic criteria for effective screening, highlighting hard-to-understand biases and introducing the concept of cost-effectiveness. The emphasis throughout is on intuitive visual explanations.

(E-12) Wednesday ● 7:00 AM
Anomalous Pulmonary Venous Return: Embryology and Imaging Spectrum

Wilson B. Chwang, MD, PhD, *Henry Ford Hospital, Detroit, MI*; Michael Mendez; David McVinnie

LEARNING OBJECTIVES: 1. Understand the embryology of the adult pulmonary veins. 2. Recognize the common types of anomalous pulmonary venous drainage. 3. Consider the pulmonary venous anomalies in the differential diagnosis of pulmonary vascular and parenchymal diseases.

CONTENT DESCRIPTION: Congenital anomalies of the pulmonary veins are rare and are often omitted from differential diagnoses of vascular and lung abnormalities. We present an overview of the embryology of the adult pulmonary veins and illustrate examples of the common types of anomalous pulmonary venous drainage. We also present a rare case report of a 72-year-old man with an anomalous lobar pulmonary vein interpreted on chest CT to represent a pulmonary arteriovenous malformation (AVM). We emphasize the importance of considering the pulmonary venous anomalies in the differential diagnosis of pulmonary vascular and parenchymal diseases.

(E-13) Tuesday ● 7:00 AM
Postpartum Cardiopulmonary Complications: Review of Imaging Findings

Sirisha Jasti, MD, *University of Rochester, Rochester, NY*; Susan K. Hobbs, MD, PhD; John C. Wandtke, MD★ (*sirisha_jasti@urmc.rochester.edu*)

LEARNING OBJECTIVES: 1. Identify the normal physiologic changes in pregnancy and the postpartum period, and describe the spectrum of postpartum cardiopulmonary complications. 2. Correlate clinical history with imaging findings to aid in narrowing the differential diagnosis, which could help the primary physician in management.

CONTENT DESCRIPTION: The physiologic changes that occur during pregnancy, such as increased blood volume and increased cardiac output, can contribute to the development of postpartum cardiopulmonary complications.

★ Faculty financial disclosures are located in the Faculty Index.

EDUCATION POSTERS

The purpose of this exhibit is to review the normal postpartum physiology and the imaging findings associated with postpartum cardiopulmonary complications. Postpartum cardiopulmonary complications are rare and can be easily misdiagnosed without proper understanding of the physiological changes during this period. In this exhibit, we intend to use sample cases to illustrate the imaging findings in a spectrum of different cardiopulmonary complications. By understanding the postpartum physiology and combining clinical history with the radiographic findings, a radiologist can narrow the differential diagnosis and aid in determining the need for subsequent imaging studies and direct clinical management.

(E-14) Wednesday ● 7:00 AM
Pulmonary Embolism: Understanding the CT Anatomy of Pulmonary Arteries

Sirisha Jasti, MD, *University of Rochester, Rochester, NY*; Susan K. Hobbs, MD, PhD (*sirisha_jasti@urmc.rochester.edu*)

LEARNING OBJECTIVES: Prompt diagnosis of pulmonary embolism can reduce the morbidity and mortality associated with it. Recent advances in CT technology suggest that perfusion mapping may soon be feasible. This exhibit will review the normal and variant anatomy of the pulmonary arteries as seen on CT angiograms, which will then facilitate future expert evaluation of more advanced studies.

CONTENT DESCRIPTION: Pulmonary embolism can be fatal if not diagnosed and treated promptly. For diagnosing pulmonary embolism, CT pulmonary angiography continues to remain the study of choice because of its noninvasive nature. This exhibit will cover the following topics: *(a)* normal and variant pulmonary arterial anatomy, with pictorial review; *(b)* review of optimal protocol for a CT pulmonary angiogram; *(c)* selected case presentation illustrating pathology; and *(d)* brief discussion of confounding factors in pulmonary embolism review. Advances in CT technology will aid in more detailed analysis of the pulmonary arterial system and pulmonary parenchyma. Thus, it is important for the radiologist to be able to recognize the segmental and subsegmental branches of the pulmonary arteries while reading CT angiography studies.

(E-15) Tuesday ● 7:00 AM
Colopleural Fistula: A Case Report Demonstrating Clinical and Radiologic Manifestations

Joseph Whetstone, MD, *Oregon Health and Science University, The Dalles, OR*; Mark Kettler, MD (*whetstoj@ohsu.edu*)

LEARNING OBJECTIVES: 1. Identify radiologic manifestations of colopleural fistulas. 2. Describe reported causes and clinical findings of colopleural fistulas, including "Sister Leena's sign."

CONTENT DESCRIPTION: Colopleural (CP) fistula with fecopneumothorax is a rare clinical entity. Reported etiologies include colonic perforation, colonic or mesenteric malignancies with erosion through the diaphragm, trauma, Crohn disease, diverticulitis, and as an iatrogenic surgical complication. This poster depicts the case of a 62-year-old woman who developed a CP fistula following blunt abdominal trauma when colon herniated into the thoracic cavity through a defect of the left hemidiaphragm and became obstructed. This poster will review the imaging and clinical findings, including Sister Leena's sign, and discuss management of CP fistulas.

(E-16) Wednesday ● 7:00 AM
Injection Rates for Catheters and IVs: How Much Can You Push It?

Benjamin C. Jacobs, MD, *University of Pittsburgh Medical Center, Pittsburgh, PA*; Yun R. Sheu, MD; Stamatis Kantartzis, MD; Philip D. Orons, DO (*sheuy@upmc.edu*)

LEARNING OBJECTIVES: On-call residents often deal with issues regarding the appropriateness of various catheters for CT angiography, which requires high flow rates. This exhibit seeks to: 1. Familiarize the reader with the various descriptors used for catheters, such as French and gauge, and how they are measured. 2. Explain the fluid mechanics involved in catheter injection and the pressures generated. 3. Allow the reader to be able to visually differentiate among the various types of peripheral and central catheters used and determine their injection rates and appropriateness for a given study. 4. Understand the previous research done on maximum injection rates and the potential adverse outcomes.

CONTENT DESCRIPTION: I. Explanation of gauge and French calculation; the size relationship between the two will be explained and depicted in chart form. II. Illustrations showing the forces generated during rapid contrast injection, as well as potential causes and sites of catheter failure. III. Visual guide of the most commonly encountered catheters and their distinguishing characteristics; special emphasis will be placed on showing where to locate injection rates, which are often listed on the catheters. IV. Description of the parameters programmable into power injectors and their significance. V. Injection rates for various examinations. VI. Review of previous studies performed that tested catheters beyond their recommended injection rates and the adverse sequelae. VII. Information on how to troubleshoot or adjust parameters in emergent situations when only a suboptimal catheter is available.

Conclusion: CT angiography requires high flow rates to generate optimal diagnostic quality. Residents need to be familiar with the various types of commonly used catheters to ensure patient safety, obtain the best possible study, and guide ordering physicians.

(E-17) Tuesday ● 7:00 AM
Pulmonary Infarction: Beyond Pulmonary Emboli—Imaging Findings of Other Etiologies and the Important Treatment Implications Every Radiologist Should Know

Erin Moody, *University of Texas Southwestern, Dallas, TX*; Sabina Amin, MD; Kirk Jordan, MD

Purpose: The imaging findings of pulmonary infarction classically include a peripheral wedge-shaped region of consolidation, but the findings are fairly nonspecific. More importantly, the discovery of an infarction should trigger a detailed search for the etiology, as this can have important management implications. Pulmonary infarctions are often associated with bland thrombus pulmonary emboli in the adult population but may appear as the sequelae of postsurgical complications, cancer, vasculitis, trauma, fibrosing mediastinitis, sickle cell disease, and air, fat, tumor, septic, amniotic fluid, and foreign body emboli. In the pediatric population, the differential includes nephrotic syndrome, sickle cell disease, cancer/chemotherapy, inherited hypercoagulable condition, heart disease, trauma, dehydration, and hyperalimentation.

Material and Methods: A pictorial review of several important conditions leading to pulmonary infarction that the radiologist needs to be familiar with is presented, to illustrate the key imaging findings to be aware of when making a diagnosis.

Results: The pictorial review includes pulmonary infarctions due to various etiologies, such as bland thrombus, postsurgical complications, cancer, vasculitis, trauma, fibrosing mediastinitis, sickle cell disease, emboli (air, fat, tumor, septic, amniotic fluid, and foreign body emboli), and pediatric-specific etiologies. There will be a quiz tutorial at the end of the presentation to reinforce the important concepts.

Conclusion: The discovery of a pulmonary infarction should trigger a detailed search for its etiology, as this has important management implications that must be relayed to the clinician. Therefore, it is essential to know the related imaging findings that allow the interpreter to narrow the list of potential causes to a succinct differential.

(E-19) Tuesday ● 7:00 AM
Cardiac MR Imaging: A Primer Illustrating Classic Cases and Diagnostic Conundrums

John N. Morelli, MD, *Scott and White Memorial Hospital, Temple, TX*; Clint M. Gerdes, MD; Megan R. Saettele, MD; Danial S. Bokhari; Lan Vu, PhD; Val M. Runge, MD★ (*dr.john.morelli@gmail.com*)

LEARNING OBJECTIVES: 1. Explain basic technical issues of cardiac MRI. 2. Describe the appearance of the most common pathologies identified on cardiac MRI. 3. Understand diagnostic dilemmas in cardiac MR imaging, utilizing this knowledge to produce an accurate differential diagnosis for a given imaging finding.

CONTENT DESCRIPTION: A resident's initial foray into cardiac MR imaging can be daunting. To help ease this transition at our institution, we have created, by searching for cases performed within the last 5 years at our institution, an atlas illustrating the classic appearance of major cardiac pathologies as identified on state-of-the-art high-field cardiac MRI. Portions of this atlas will be presented herein. Technical subjects to be introduced include gating/triggering, bright/dark blood imaging, and

acquisition of TI scout as well as first-pass and delayed contrast-enhanced imaging. Standard cardiac imaging planes, anatomy, and patient safety issues will also be discussed. Illustration of cardiac pathology proceeds along anatomic lines, including entities affecting the myocardium, such as myocarditis, infiltrative disorders, and myocardial noncompaction. An emphasis is placed upon myocardial ischemia, with illustration of viable/nonviable hibernating myocardium and no-reflow phenomenon. Valvular stenoses, insufficiencies, and prolapse will be illustrated, with an introduction to phase-contrast imaging and flow quantification. Cardiac neoplasms such as myxomas, lipomas, and rhabdomyosarcomas are also illustrated, along with mimics such as cardiac thrombus. An overview of pediatric heart disease is provided, including aortic coarctation, septal defects, and cyanotic heart disease. After viewing this poster, residents will emerge with an improved overall knowledge of cardiac imaging, prepared for their first rotation in cardiac MRI.

(E-21) Tuesday ● 7:00 AM
Clinical Trial Statistics: The Graphic Novel

Stefan Tigges, MD, *Emory Clinic, Atlanta, GA* (*stigges@emory.edu*)

LEARNING OBJECTIVES: 1. List three possible explanations for any clinical trial outcome. 2. Define and recognize bias and random error. 3. Define the null and alternative hypotheses. 4. Define and explain the difference between the terms "α level" and "P value." 5. Explain how and why hypothesis testing and statistical inference are used in clinical trial analysis.

CONTENT DESCRIPTION: Virtually every published medical research study is brimming with statistics, but much of this material, including P values and α levels, is opaque to students and many physicians. This short graphic novel is intended to familiarize readers with the core reason for performing statistical tests and the limits of this type of analysis. The emphasis throughout is on intuitive visual explanations, with as little math as possible. Readers will learn that there are only three possible explanations for any clinical trial result and how to assess the role of bias and random error. Hypothesis testing is explored in depth, using a nontechnical approach to the meaning of α level and P value.

(E-22) Wednesday ● 7:00 AM
Are You Ready for July? Development of a Precall Test to Assess the Readiness of 1st-Year Radiology Residents to Begin Taking Independent Call

David Nickels, MD, MBA; Andres Ayoob, *University of Kentucky, Lexington, KY*; Matthew E. Maxwell, MD; Edward Escott; Gustav Blomquist

LEARNING OBJECTIVES: 1. Discuss limitations of precall preparation of 1st-year radiology residents and the difficulty of accurate assessment of preparedness for the challenges of call. 2. Describe the approach taken at the University of Kentucky to develop a formalized test that would evaluate residents before they begin call. 3. Explore possible improvements for next year and beyond.

CONTENT DESCRIPTION: Before the development of a dedicated emergency radiology division at the University of Kentucky, the call preparation was left up to each subspecialty division. Many precall tests have been utilized over the years, but nothing was ever documented formally; there were many changes and inconsistencies from year to year. With the implementation of a dedicated emergency radiology division, there arose an opportunity to formalize our precall preparation both through a focused lecture series and through a formalized set of tests that would assess the readiness of each 1st-year resident before the first independent call experience. Standardized tests covering radiography and body cross-sectional imaging were developed to examine our 1st-year residents in these critical domains. With the help of the neuroradiology division, a neuroradiology test was also developed. Each of these three tests was administered to each of the six 1st-year radiology residents and to each of the six 2nd-year radiology residents. The latter were tested to provide additional data points and to serve as a benchmark for increased knowledge base and interpretive skills gained after an additional year of residency training. Each test was designed to be administered on a full PACS workstation with limited clinical history. Each resident recorded his/her "Findings and Impression" for each case on paper, and the responses were graded by faculty. Normal examinations were incorporated into each test to add complexity and to simulate the "real-life" scenario. Overall, the tests were well received by the residents. Each 1st-year resi-

dent was deemed ready for independent call. The expected levels of increased knowledge base and interpretive skills of the 2nd-year residents were validated.

(E-25) Tuesday ● 7:00 AM
The Virtual Resident Portfolio: Keeping the Learning Portfolio Relevant in the 21st Century

Patrick J. Millerd, MD, *University of Nebraska Medical Center, Omaha, NE*; Matthew DeVries, MD; Tina Hunter

Purpose: The purpose is to demonstrate an easily reproducible approach integrating the traditional components of the learning portfolio into the evaluation process, creating a virtual portfolio.

Background: The learning portfolio is an ACGME requirement often overlooked or created retrospectively by busy radiology residents, usually long after the interactions and learning opportunities the portfolio should emphasize. The learning portfolio thus loses its potential value as a tool to create learning plans and to document interactions that demonstrate application of ACGME core competencies.

Method and Materials: First, we created a new self-evaluation that is completed prior to the start of each rotation, which prompts residents to create a rotation-specific learning plan based on self-reported strengths and weaknesses. Then components of the traditional learning portfolio were integrated into the evaluation completed at the end of each rotation (eg, learning plan effectiveness, medical decision making, and multidisciplinary communication and teaching interactions).

Results: The virtual portfolio promotes timely thoughtful documentation and more-relevant specific learning plans because it is updated at each rotation. Although we have not gathered scientific data, results from an informal survey of current residents will be presented. Responses generally indicate that the virtual portfolio is perceived as a more effective and useful learning tool.

Conclusion: We have integrated the learning portfolio into the electronic evaluation process, creating a virtual portfolio. Because the virtual portfolio is integrated with the evaluation cycle, learning plans as well as multidisciplinary interactions that exemplify ACGME core competencies are captured closer to the point of occurrence, which results in more relevant and thoughtful documentation. Our approach can be easily generalized to any evaluation process. Finally, the virtual portfolio has other potential applications, such as powering a new master checklist: a resident-specific tool that offers a snapshot of ACGME compliance and tracks progress toward graduation requirements.

(E-26) Wednesday ● 7:00 AM
Artistic Expression for Diagnostic Imaging: Thinking Outside the Light Box

Stacey O. Verzosa, MD, *Beth Israel Medical Center, New York, NY*; Marlene E. Rackson, MD; Douglas S. Katz, MD (*stacey.verzosa@yahoo.com*)

LEARNING OBJECTIVES: 1. Raise awareness of how diagnostic images are used in art. 2. Provide examples of how to use existing diagnostic images to create art. 3. Show how using radiology as art allows patients to relate to our specialty through media that are familiar to them. 4. Inspire radiologists to be creative with the tools that they have.

CONTENT DESCRIPTION: I. Examples using various modalities will be shown: computed radiography (CR), CT, MRI, and ultrasound. II. Professional artists incorporating images into their art will be demonstrated and discussed (eg, Nick Veasey and Leslie Wright). III. Techniques for creating art will be shown and discussed: using existing diagnostic images, inanimate objects, animate objects, and combinations. IV. Using radiology art as a method of relating to patients will be explained.

Conclusion: Radiologic images have become a popular medium for professional artists. Various modalities, including CR, CT, MRI, and ultrasound, have been integrated into creative images. Awareness of this growing trend can help both practicing radiologists and patients discover the world of radiology outside of the work setting, allowing them to relate to our field in a new light.

★ Faculty financial disclosures are located in the Faculty Index.

EDUCATION POSTERS

(E-28) Wednesday ● 7:00 AM
The Law and the Light Box: An Overview of Health Care Law for the Radiologist

Jonathan Flug, MD, MBA, *Winthrop-University Hospital, Mineola, NY*; Grace Mitchell, MD, MBA; Amit S. Sura, MD, MBA; Stuart Cohen, MD; Naveen Kankanala, MD, MBA; Marcia Boumil, JD (*jflug@winthrop.org*)

LEARNING OBJECTIVES: 1. Describe the history of selected legal proceedings in the United States, and discuss how they have influenced the health care environment in which we practice today. 2. Describe implications for the radiologist practicing in today's medicolegal environment.

CONTENT DESCRIPTION: As with all branches of medicine, the practice of radiology has been shaped by multiple influencing factors, including incredible technological advancements and scientific discoveries. Similarly, but perhaps less tangibly, medicine has also long been molded by legal concepts and landmark cases. Today the disciplines of medicine and health care law increasingly overlap, and a basic understanding of these key concepts will better equip modern radiologists to navigate the ever-evolving relationship.

Content Organization: I. Introduction. II. Legal and ethical topics, with specific legal cases and implications for the radiologist. A. Doctor-patient relationship. B. Negligence and standard of care. C. For-profit and not-for-profit institutional liability. D. Good samaritan laws. E. Emergency care. F. Informed consent. G. Patient autonomy. H. Health care regulation, finance, and managed care. I. Medical staff regulation. J. Protection and peer review. K. Conflict of interest. III. Summary.

(E-31) Tuesday ● 7:00 AM
Imaging-guided Percutaneous Abdominal and Pelvic Abscess Drainage

John Pietila, MD, *University of Michigan Health System, Ann Arbor, MI*; Katherine A. Klein, MD; Jonathan R. Dillman, MD★; Elaine M. Caoili, MD

LEARNING OBJECTIVES: 1. Identify the indications and contraindications for imaging-guided percutaneous drainage of abdominal and pelvic abscesses. 2. List common imaging approaches and their advantages and disadvantages. 3. Describe the steps of the procedure for both the Seldinger and trocar techniques. 4. Identify both common and uncommon complications of imaging-guided percutaneous drainage of abdominal and pelvic abscesses. 5. Describe how to manage the patient and drainage catheter after the procedure.

CONTENT DESCRIPTION: *Content Organization:* A. Clinical findings. B. Differential diagnosis. C. Diagnostic imaging approaches, including ultrasound and computed tomography (CT). D. Indications/contraindications to percutaneous drainage. E. Percutaneous management strategies (including both trocar and Seldinger techniques). F. Complications. G. Postprocedure management of patient and drainage catheter.

Summary: Imaging-guided percutaneous drainage is the preferred treatment of abdominal and pelvic abscesses when urgent or emergent surgery is not indicated. The indications and contraindications for percutaneous management of abdominal and pelvic abscesses are presented, along with step-by-step illustration of the trocar and Seldinger techniques. Common and uncommon procedural complications will be illustrated, and postprocedure management will be discussed.

(E-32) Wednesday ● 7:00 AM
What Is in Your DVT Toolbox? A Review of Endovascular Techniques to Treat Deep Venous Thrombosis

(FDA)

Chirdeep Bhutani, MD, *William Beaumont Hospital, Royal Oak, MI*; Matthias J. Kirsch, MD; Joseph Ciacci, DO

LEARNING OBJECTIVES: 1. Describe the role of and indications for endovascular treatment of deep venous thrombosis (DVT). 2. Identify and illustrate the endovascular tools available for treatment of DVT.

CONTENT DESCRIPTION: *Background:* DVT and its sequelae present a major challenge in modern health care. Endovascular management has attracted attention as a safe and effective tool, offering preservation of valve function, correction of inciting anatomical predispositions, and preventing postthrombotic syndrome.

Endovascular Techniques and Tools, with Illustrative Examples: 1. Catheter-directed thrombolysis. 2. Lytic assisted clot-removing devices. 3. Catheter aspiration thrombectomy. 4. Mechanical thrombectomy devices. 5. Angioplasty/stenting.

Conclusion/Teaching Points: 1. Endovascular treatment of DVT is valuable for accelerated relief of symptoms and for significantly reducing the incidence of postthrombotic syndrome. 2. Interventionalists should be familiar with the various devices available, to optimize treatment strategies for DVT.

(E-33) Tuesday ● 7:00 AM
Percutaneous Management of a Dysfunctional Endoscopically Placed Metallic Biliary Endoprosthesis

(FDA)

Chirdeep Bhutani, MD, *William Beaumont Hospital, Royal Oak, MI*; Purushottam K. Dixit, MD

LEARNING OBJECTIVES: 1. Identify the indications for percutaneous management of a dysfunctional endoscopic metallic biliary endoprosthesis. 2. Describe tools and techniques available to alleviate biliary obstruction.

CONTENT DESCRIPTION: *Background:* Biliary obstruction caused by unresectable malignancy is often treated by placement of biliary stents. Endoscopic and percutaneous techniques are utilized for placement and management of such biliary stents. Most endoscopically placed plastic stents are easily removed/exchanged. Endoscopic metallic stents have recently gained popularity. Since metallic biliary stents are not easily retrieved endoscopically, interventional radiology is often involved in cases where endoscopic stents are dysfunctional.

Techniques and Tools for Management of Occluded/Displaced Biliary Stents: Multiple novel percutaneous management techniques for dysfunctional metallic stents will be demonstrated: *(a)* puncture of interstices of displaced metallic stent for drain placement, *(b)* parallel stenting, *(c)* placement of biliary drainage catheter endoluminally or external to the dysfunctional metallic stent, *(d)* endoluminal restenting with plastic or metallic stent, *(e)* balloon plasty, *(f)* stent retrieval, and *(g)* Y-stenting.

Conclusion/Teaching Points: There are multiple percutaneous techniques to manage an occluded or misplaced metallic biliary endoprosthesis. Novel methods such as demonstrated above provide an alternative to surgical intervention in a dysfunctional endoscopically placed metallic biliary endoprosthesis.

(E-34) Wednesday ● 7:00 AM
Interventional Radiology for the Medical Student: A Novel Curriculum

Alan A. Sag, MD, *William Beaumont Hospital, Royal Oak, MI*; Michael Trpkovski; Matthias J. Kirsch, MD; David A. Bloom, MD

LEARNING OBJECTIVES: 1. Explain the importance of educating future interventional radiologists at the medical student level, including the specialty definition of interventional radiology (IR), competition and collaboration with non-IR specialties interested in imaging and procedures, and developing new and anticipated training pathways, including DIRECT, clinical, and primary certificate pathways. 2. Implement the provided Comprehensive Year 1 through Year 4 Curriculum and Core Case Bank material of 10 evidence-based clinical IR cases as a template for education. 3. Implement the provided Resources Bank for structured mentorship by residents, fellows, and attendings, including grant and scholarship opportunities, research presentations and publications, interventional radiology clerkships, and SIR membership and meeting attendance.

CONTENT DESCRIPTION: The dynamic future of interventional radiology is structured by continued selection and specialization of dedicated physician candidates who are willing to provide compassionate and cutting-edge patient care through advanced minimally invasive techniques. IR is at the center of health care and provides consultation to patients seen by almost every other subspecialty; however, formal introduction to IR is not yet standardized in allopathic training pathways. The visibility of IR will determine medical student interest, and there is a vital opportunity to teach all future doctors about the scope of IR practice, as well as mentor candidates to successful IR careers. The Comprehensive Year 1 through Year 4 Curriculum is optimized for each level of training and combines with Core Case Bank material to guide education in gross anatomy, genetics, pathology, ethics, and other courses. Key points in mentorship include

★ Faculty financial disclosures are located in the Faculty Index.

the Resource Bank, IR 3rd-year clerkship (as part of the routine clerkship upon request), and competitive residency application process. This structured and dynamic curriculum has plasticity to suit any medical school environment and will engage medical students in a vital curriculum while energizing future interventional radiologists.

(E-35) Tuesday • 7:00 AM
Radiologic-Pathologic Correlation of Image-guided Percutaneous Rib Biopsy

Raymond Lee, MD, *Winthrop-University Hospital, Mineola, NY*; Asante M. Dickson, MD; Man Hon, MD; A. Orlando Ortiz, MD, MBA★; Yun-an Tseng, DO; Steven Drexler, MD (*rlee1@winthrop.org*)

LEARNING OBJECTIVES: 1. Describe a series of consecutive image-guided percutaneous rib biopsies with radiologic-pathologic correlation. 2. Discuss the technical aspects of this procedure.

CONTENT DESCRIPTION: *Method and Materials:* A retrospective review of consecutive image-guided (CT or CT fluoroscopy) percutaneous rib biopsies at our institution was performed, which included 19 cases from 2008 to the present. Coaxial technique was utilized for all procedures in order to facilitate multiple lesion-sampling attempts when technically feasible and to increase procedure efficiency/safety. For soft-tissue cores, 14–16-gauge cutting needles were used; 19-gauge guiding needles were used for FNA samples. All pathology reports were reviewed for comments with respect to the diagnosis and the technical aspects of specimen size/condition.

Results: Of the 19 patients, 16 were male, and three were female (mean age, 69 years). Five of the procedures were performed under CT fluoroscopic guidance and 14 under CT guidance. All biopsies were performed to assess for the presence of neoplasm. No significant complications were encountered in any of the cases. Of the 19 biopsies performed, 14 were positive for metastatic disease (74%), all of which either had a known malignancy or presented with metastatic disease at the time of biopsy. All 10 of the FNA biopsies yielded positive results, whereas four of the nine core biopsies yielded positive results. Of the five core biopsies that were negative for metastasis, three had no prior history of malignancy at the time of biopsy. Of those three patients, one was diagnosed with NSCLC 6 months later via lung biopsy, and two had non–biopsy-proven lesions of the pituitary gland and lung, respectively, without evidence of metastasis. Of the two negative biopsies with a prior history of malignancy, only one did not have a proper specimen for analysis, as the patient was unable to tolerate the procedure.

Study Limitations: Limitations were the small sample size and retrospective nature of the study.

Conclusion: Image-guided rib biopsy is a challenging procedure that is sometimes indicated for isolated rib lesions in patients with suspected malignancy. The procedure can be effectively and safely performed with CT imaging guidance.

(E-37) Tuesday • 7:00 AM
"Don't Let Go of the Wire!": Common Mistakes Made by Trainees during CT-guided Percutaneous Procedures and Tips on How to Correct Them

Lashonda Watts, MD, MS, *Medical University of South Carolina, Charleston, SC*; Christopher Hannegan, MD

LEARNING OBJECTIVES: 1. Review common mistakes made by trainees during CT-guided percutaneous biopsies. 2. Demonstrate correct and effective techniques. 3. Describe ways to correct mistakes when they occur during a procedure.

CONTENT DESCRIPTION: I. Prep school: properly setting up for the procedure. II. The motion in the ocean: accounting for patient motion. III. "Don't let go of the wire!": proper guidewire technique. IV. Heads up: preparing the patient for uncomfortable maneuvers. V. Measuring up: the value of precision and the pitfalls of estimating.

(E-41) Tuesday • 7:00 AM
Musculoskeletal Manifestations of Endocrinopathies

Luke R. Scalcione, MD, *Winthrop-University Hospital, Mineola, NY*; Rebecca Wu, MD, BS; Jonathan Flug, MD, MBA; Joseph P. Mazzie, DO; Michael K. Brooks, MD, MPH; Douglas S. Katz, MD (*lrs209@nyu.edu*)

LEARNING OBJECTIVES: 1. Describe pertinent pathophysiology of the thyroid gland, parathyroid glands, pituitary gland, and pancreas. 2. Describe the effects of various endocrine hormones on the musculoskeletal system. 3. Identify musculoskeletal manifestations of various endocrinopathies.

CONTENT DESCRIPTION: The educational exhibit will be organized by endocrine gland (ie, pituitary, thyroid, parathyroid, pancreas). The endocrine function/pathophysiology of the gland will be briefly reviewed, and gland-specific endocrinopathies will be discussed (ie, dysregulation of growth hormone, thyroid hormone, parathyroid hormone, insulin). By utilizing a case-based approach, the salient musculoskeletal manifestations of the various endocrinopathies will be demonstrated.

(E-42) Wednesday • 7:00 AM
Radiologic Imaging Findings of Orthopedic Hardware Failure

Trisha Youn; Carla De Venecia; Luke R. Scalcione, MD; Douglas S. Katz, MD, *Winthrop-University Hospital, Mineola, NY*; Amilcare Gentili, MD; Tudor H. Hughes, MD, FRCR (*luke.scalcione@gmail.com*)

LEARNING OBJECTIVES: 1. Describe the usual imaging findings of various orthopedic hardware devices, including, but not limited to, lag screws, cortical screws, syndesmotic screws, dynamic hip screws, unicompartmental and total knee arthroplasties, and hip hemiarthroplasties and total arthroplasties (cemented and noncemented). 2. Identify how each specific hardware device may fail, and describe the imaging appearances of hardware failure.

CONTENT DESCRIPTION: Each case will depict the normal imaging findings of various orthopedic hardware devices and include a discussion of biomechanics and a review of the imaging findings of hardware failure. The results will be presented by utilizing high-quality conventional radiographs, computed tomographic images, and magnetic resonance images from our institution. The imaging findings specific to the postoperative orthopedic patient may often pose a challenge to the radiologist, as numerous orthopedic devices have different roentgenographic appearances. A sound knowledge of the normal imaging characteristics of these devices and the biomechanical mechanisms of hardware failure is important for the radiologist to understand in order to accurately diagnose the imaging sequelae of hardware failure.

(E-44) Wednesday • 7:00 AM
Eponyms and Acronyms of Glenoid Labral Pathology: A Review

Christian S. Geannette, MD, *New York-Presbyterian Hospital–Weill Cornell Medical Center, New York, NY*; Kevin W. Mennitt, MD; Eric Bogner, MD

LEARNING OBJECTIVES: 1. Review basic glenoid labral anatomy, several normal variants, and a variety of glenoid labral lesions, including SLAP (superior labrum anterior-to-posterior) tear, Perthes lesion, Bankart (bony and fibrous) lesion, Hill-Sachs lesion, ALPSA (anterior labroligamentous periosteal sleeve avulsion), HAGL (humeral avulsion of the glenohumeral ligament), and GLAD (glenoid labrum articular disruption). 2. Discuss the subtle differences that distinguish glenoid labral lesions. 3. Describe cross-sectional imaging appearances of the glenoid labrum and of a variety of glenoid labral lesions.

CONTENT DESCRIPTION: I. Review of glenoid labral anatomy, adjacent anatomy (including the glenohumeral ligaments and biceps), and normal variants that may be mistaken for pathology. II. Cross-sectional imaging (mainly MRI) of cases of the following lesions: SLAP (superior labrum anterior-to-posterior) tear, Perthes lesion, Bankart (bony and fibrous) lesion, Hill-Sachs lesion, ALPSA (anterior labroligamentous periosteal sleeve avulsion), HAGL (humeral avulsion of the glenohumeral ligament), and GLAD (glenoid labrum articular disruption).

EDUCATION POSTERS

★ Faculty financial disclosures are located in the Faculty Index.

(E-45) Tuesday • 7:00 AM
The Meniscus: Understanding Meniscal Anatomy, Function, and Tears

Jonathan Ghassemi, MD, *New York-Presbyterian Hospital–Weill Cornell Medical Center, New York, NY*; Kevin W. Mennitt, MD

LEARNING OBJECTIVES: 1. Describe the historical background of the development of our present understanding of the meniscus. 2. Identify normal anatomy and basic functions of the meniscus. 3. Describe MRI interpretation of the normal meniscus and the different types of meniscal tears.

CONTENT DESCRIPTION: I. Review of the evolving understanding of the meniscus from the mid-1800s to the present. II. Discussion of the four basic functions of the meniscus, including load distribution, shock absorption, joint lubrication and nutrition, and knee stability. III. Review of normal meniscal anatomy, including blood supply, composition and arrangement of fibrocartilages, and relationship to surrounding ligaments and osseous structures. IV. Presentation of cases to exhibit MRI evaluation of the normal meniscus and cases demonstrating evaluation of the different types of meniscal tears, including horizontal, longitudinal, bucket-handle, radial, and oblique tears.

(E-46) Wednesday • 7:00 AM
Cased-based MR Imaging Review of Foot and Ankle Masses and Lesions

Tahira G. Fasihi, MD, *Rochester General Hospital, Rochester, NY*; Roman Kowalchuk, MD, PhD

LEARNING OBJECTIVES: The purpose of this exhibit is to *(a)* review the best MRI cases of the foot and ankle attained over +5 years from a busy urban hospital and orthopedic-driven musculoskeletal radiology private practice in western New York and *(b)* compare and contrast similar-appearing lesions and mimics. By viewing this exhibit, the viewer will be able to: 1. Identify salient anatomy of the foot and ankle as seen on MRI. 2. Confidently recognize foot and ankle lesions on MRI, and provide a knowledgeable differential diagnosis. 3. Recognize "do not touch" lesions of the foot and ankle, thereby guiding appropriate management.

CONTENT DESCRIPTION: I. Salient anatomy of the foot and ankle on MRI. II. Foot and ankle MRI cases, including obscure pathology-proven cases and more prevalent cases, with review of common mimics. III. Example of cases: cutaneous myxoma, squamous cell carcinoma, Frieberg's infraction, osteochondritis dissecans, enchondroma, Morton's neuroma, unicameral bone cyst, intraosseous lipoma, osteonecrosis, os trigonum syndrome, plantar fasciitis, and mimics. IV. Summary of content, with emphasis on differentiating among lesions.

(E-47) Tuesday • 7:00 AM
Sports Activity–related Musculoskeletal Injuries in the Adolescent and Pediatric Population from an Imaging Perspective

Kevin S. Baker, *Stony Brook University School of Medicine and Medical Center, Stony Brook, NY*; Elaine S. Gould, MD; Mingqian Huang, MD; Freeman Hwang, MD

LEARNING OBJECTIVES: 1. Describe the spectrum of findings in pediatric and adolescent sports-related injuries from a musculoskeletal perspective. 2. Identify imaging modalities that demonstrate certain specific patterns of injuries. 3. Describe the long-term sequelae of certain injuries.

CONTENT DESCRIPTION: With the increased emphasis on sports at earlier ages, the authors not only are observing an increase in the numbers, types, and severity of injuries but also are noting injuries that were more commonly seen in older patients and young adults.

Content Organization: I. Type of sports-related injuries seen in the pediatric and adolescent population. II. Review of imaging findings: plain film, CT, and MRI. III. Review of the spectrum of injuries, from the more classic injuries in the upper and lower extremities to the more subtle and esoteric. IV. Sample imaging cases of bone and soft-tissue injury. V. Examples of long-term sequelae of some injuries. VI. Data collected from 2003 to the present. VII. Summary/future directions.

Conclusions/Major Teaching Points: 1. Musculoskeletal-related injuries are being seen in younger age groups. 2. The pattern of some injuries is paralleling the more common adult-type injuries. 3. Complications/chronic sequelae should be recognized.

(E-48) Wednesday • 7:00 AM
MR Imaging of Ankle Impingement Syndromes: A Pictorial Review

Lauren Chang Sen, MD, *University of Pittsburgh, Pittsburgh, PA*; Bethany U. Casagranda, DO; Cynthia A. Britton, MD

LEARNING OBJECTIVES: 1. Identify pathophysiology and clinical presentation of ankle impingement syndromes (anterolateral, anterior, anteromedial, posteromedial, and posterior). 2. Recognize MR imaging characteristics in ankle impingement syndromes. 3. Describe treatment options of impingement syndromes at the ankle joint.

CONTENT DESCRIPTION: I. Define normal anatomy at the ankle joint. II. Review pathophysiology and clinical presentation of ankle impingement syndromes (anterolateral, anterior, anteromedial, posteromedial, and posterior). III. Demonstrate role of MRI in diagnosing various ankle impingement syndromes and assessing treatment outcome. IV. Explore different treatment options and clinical outcome.

(E-49) Tuesday • 7:00 AM
Tendon Injuries of the Ankle: Incidence, Diagnosis, and Treatment

Lauren Chang Sen, MD, *University of Pittsburgh, Pittsburgh, PA*; Bethany U. Casagranda, DO; Cynthia A. Britton, MD

LEARNING OBJECTIVES: 1. Describe the incidence and clinical presentation of tendon injuries at the ankle joint (anterior tibial, peroneus longus and brevis, posterior tibial, and Achilles tendons). 2. Identify MR imaging characteristics of various tendon injuries. 3. Explain different treatment options of tendon injuries at the ankle joint.

CONTENT DESCRIPTION: I. Define normal tendon anatomy at the ankle joint. II. Review the incidence and clinical presentation of tendon injuries at the ankle joint (anterior tibial, peroneus longus and brevis, posterior tibial, and Achilles tendons). III. Demonstrate the role of MRI in diagnosing tendon injuries at the ankle joint and evaluating tendons after treatment. IV. Explain different treatment options and clinical outcome.

(E-51) Tuesday • 7:00 AM
Adamantinoma, Ewing Sarcoma, and Somewhere in Between: A Radiologic-Pathologic Correlation

Riyam Zreik, MD; John N. Morelli, MD, *Scott and White Memorial Hospital, Temple, TX*; Danial S. Bokhari; Russell Ward, MD; Linda Parman, MD; Matthew B. Crisp, MD (*dr.john.morelli@gmail.com*)

LEARNING OBJECTIVES: 1. Review and illustrate the characteristic imaging findings of osteofibrous dysplasia, adamantinoma, and Ewing sarcoma. 2. Describe and illustrate the imaging appearance of adamantinoma-like Ewing sarcoma. 3. Describe and illustrate the gross pathologic and histologic appearances of the above entities.

CONTENT DESCRIPTION: Along the spectrum of Ewing family tumors, adamantinoma-like Ewing sarcoma is the rarest entity. Considerable controversy exists as to whether this lesion represents a primary adamantinoma or Ewing-type lesion. In this exhibit, the radiographic, MR, CT, bone scan, and PET imaging appearance of an adamantinoma-like Ewing sarcoma will be described, a description not previously found in the English literature. Correlation with intraoperative, gross, and histologic pathologic findings will be made. The differential diagnosis for such lesions will be discussed and illustrated, including a detailed review of the common radiologic and pathologic appearances of adamantinomas, osteofibrous dysplasia, and Ewing sarcomas. Emphasis will be placed on key points of radiologic and pathologic distinction among these lesions.

(E-52) Wednesday • 7:00 AM
Hybrid SPECT/CT Endocrine Scintigraphy: A Pictorial Review

Ehab H. Youssef, MBBCh, MD, PhD, *University of Michigan, Ann Arbor, MI*; Ka Kit Wong, MBBS (*ehaby@med.umich.edu*)

LEARNING OBJECTIVES: 1. Describe the advantages of hybrid SPECT/CT over planar and SPECT alone in endocrine scintigraphy. 2. Identify new applications of endocrine SPECT/CT scintigraphy.

CONTENT DESCRIPTION: *Introduction:* Nuclear medicine imaging allows depiction of pathological distributions of radiotracer activity and has relied on planar and SPECT acquisition techniques for many decades. The availability of hybrid SPECT/CT cameras now allows combined multimodality imaging in a single diagnostic session, with rapid highly efficient fusion of 3D volumetric data sets.

Method and Materials: The advantages of hybrid SPECT/CT can be broadly categorized as *(a)* precise localization of the radioactivity, *(b)* improved characterization of radioactivity and higher diagnostic accuracy, *(c)* additional anatomic information from the CT component, *(d)* CT-based attenuation correction and potential for volumetric dosimetry calculations, *(e)* increased reader confidence and interobserver agreement, and *(f)* impact on patient management (eg, change in treatment plans, shortened surgical operating times). We illustrate these benefits using a spectrum of cases performed on a SPECT/CT camera (Symbia T16; Siemens), including ^{123}I/^{131}I radio-iodine for staging of differentiated thyroid carcinoma (DTC), ^{111}In- and ^{99m}Tc-labeled somatostatin receptor analogues for detection of neuroendocrine tumors (NETs), ^{131}I-norcholesterol (NP-59) for assessment of adrenal cortical hyperfunction, ^{123}I/^{131}I metaiodobenzylguanidine (MIBG) for evaluation of pheochromocytomas and paragangliomas, ^{99m}Tc-sestamibi parathyroid scintigraphy, and ^{99m}Tc-pertechnetate thyroid scintigraphy. We also performed a PubMed search using the terms SPECT-CT, SPECT/CT, functional anatomic mapping, and transmission emission tomography and summarize the articles in the literature describing applications of endocrine SPECT-CT scintigraphy.

Conclusion: Hybrid SPECT/CT is a rapidly emerging dual-modality imaging technique with incremental diagnostic utility when applied to nuclear medicine imaging of endocrine disorders.

(E-53) Tuesday • 7:00 AM
Review of Blind Spots and Pitfalls in ^{18}F-FDG PET/CT

Ehab H. Youssef, MBBCh, MD, PhD, *University of Michigan, Ann Arbor, MI*; Mohammad Arabi; Richard K. Brown, MD★ (*ehaby@med.umich.edu*)

LEARNING OBJECTIVES: 1. Describe the variability of physiologic uptake of ^{18}F-FDG. 2. Identify potential pitfalls in ^{18}F-FDG PET/CT that can obscure disease. 3. Describe useful techniques to avoid these blind spots created by physiologic uptake of tracer.

CONTENT DESCRIPTION: I. Physiologic biodistribution of ^{18}F-FDG. II. Blind spots as potential pitfalls in: A. Brain. B. Heart. C. Gastrointestinal tract. D. Skeletal muscles. E. Upper and lower urinary tract. III. Useful techniques to avoid these blind spots.

Summary: Physiologic activity can potentially obscure disease in the brain, heart, gastrointestinal tract, and genitourinary and musculoskeletal systems. Blind spots created by physiologic uptake can lead to missed diagnoses. Factors that can be modified to improve image quality and subsequent diagnostic accuracy include serum glucose levels/diet, hydration status, physical activity instructions, windowing, and correlation with anatomic images.

(E-54) Wednesday • 7:00 AM
Paired Bilateral Internal Carotid Artery Aneurysms: An Imaging Review

Joseph R. Grajo, MD, *University of South Florida, Tampa, FL*; Midhir J. Patel, BS (*jgrajo@health.usf.edu*)

LEARNING OBJECTIVES: 1. Describe the incidence and pathophysiology of multiple intracranial aneurysms. 2. Describe an interesting case of paired bilateral internal carotid artery aneurysms, with a few companion cases from our institution. 3. Explain the role of various imaging techniques in the diagnosis and management of intracranial aneurysms.

CONTENT DESCRIPTION: *Introduction:* Cerebral aneurysms have wide-ranging clinical presentations and are usually diagnosed incidentally. Variety in number, size, and location of these vascular abnormalities is well documented. To the best of our knowledge, a case of bilaterally paired internal carotid artery aneurysms is exceedingly rare. This case highlights such an occurrence, in order to review the different imaging modalities that are currently available and their role in detection and treatment of intracranial aneurysms.

Method and Materials: We will discuss the utility of computed tomography angiography (CTA), magnetic resonance angiography (MRA), and cerebral angiography in the diagnosis and management of intracranial aneurysms. Our case includes discussion of the patient's history and unique radiologic findings. The use of imaging for treatment will also be emphasized.

Results: Radiologic findings of bilaterally paired internal carotid artery aneurysms and other companion cases will be presented.

Conclusion: The diagnosis and management of cerebral aneurysms are critically dependent on imaging. Modalities such as CTA, MRA, and cerebral angiography provide unprecedented precision in evaluation of intracranial aneurysms. This case demonstrates the importance of considering these vascular anomalies in the differential diagnosis for various clinical presentations.

(E-55) Tuesday • 7:00 AM
Multifocal Myxoepithelial Ependymoma: A Case Report

Joseph R. Grajo, MD, *University of South Florida, Tampa, FL*; Gitasree Borthakur, BS; Thora S. Steffensen, MD; Natasa Dragicevic, MD, PhD (*jgrajo@health.usf.edu*)

LEARNING OBJECTIVES: 1. Identify the typical imaging characteristics of spinal cord ependymomas. 2. Describe the presentation and radiologic features of a unique case of multifocal myxoepithelial ependymoma.

CONTENT DESCRIPTION: *Introduction:* Myxopapillary ependymomas are a rare subtype of intramedullary CNS tumors. They constitute less than 4% of all primary CNS tumors in adults and tend to form centrally within the spinal cord. These tumors exhibit low mitotic activity and cause insidious nonspecific local pain in the lower back, leg, or sacral regions. We will discuss a rare case of myxopapillary ependymoma that presented with multiple nodular enhancing masses throughout the spinal cord.

Material and Methods: On MRI, ependymomas often appear as symmetric expansions of three to four segments of the spinal cord and are hypointense or isotense compared to normal cord on T1-weighted images, with variable signal on T2-weighted images. Postcontrast T1-weighted imaging can improve definition of tumor margins, identify additional tumor cysts, and aid in interpretation of spinal cord after surgical manipulation.

Results: MR imaging revealed multiple enhancing nodular masses throughout the thoracic and lumbar spinal cord, without a focal point of origin. These findings suggested possible drop metastases or leptomeningeal carcinomatosis. However, radiologic work-up and laboratory values did not reveal a source of primary malignancy. Biopsy of an L5-S1 mass demonstrated myxopapillary ependymoma. Correlation with histologic images and pathologic discussion will be presented.

Conclusion: MRI can noninvasively identify myelopathies and is the imaging modality of choice to investigate spinal cord lesions. Distinguishing ependymomas from other CNS neoplasms is important because these tumors can often be completely resected without need for further treatment. Delay in diagnosis is often due to the nonspecific nature of symptoms. Although myxopapillary ependymoma tends to present as symmetric expansions of focal areas of the spinal cord, this case demonstrates an unusual multinodular presentation of myxopapillary ependymoma on MRI.

★ Faculty financial disclosures are located in the Faculty Index.

EDUCATION POSTERS

(E-56) Wednesday • 7:00 AM
An Unusual Radiologic Appearance of Disk Extrusion Causing Cauda Equina Syndrome

Joseph R. Grajo, MD, *University of South Florida, Tampa, FL*; Shamima Y. Ahmed, BS; Thora S. Steffensen, MD; Natasa Dragicevic, MD, PhD (*jgrajo@health.usf.edu*)

LEARNING OBJECTIVES: 1. Understand the clinical presentation of cauda equina syndrome (CES). 2. Review the various etiologies of CES. 3. Review the imaging characteristics of an unusual MR imaging appearance of disk extrusion causing early CES.

CONTENT DESCRIPTION: *Introduction:* Cauda equina syndrome (CES) signifies an injury of multiple lumbosacral nerve roots. The classic triad of low back pain, weakness/areflexia in the legs, and loss of bladder function may occur. CES can have various etiologies but is most commonly seen in a ruptured lumbosacral intervertebral disk, lumbosacral spine fracture, hematoma following lumbar puncture, or tumor.

Method and Materials: Diagnosis of CES requires the combination of history, physical exam, and imaging studies. Definitive diagnosis can be established by myelogram or epidurogram. It confirms both the location and position of the entrapped nerve root. However, MRI of the lumbar spine is the diagnostic modality of choice, as it noninvasively demonstrates the adjacent intraspinal and soft-tissue anatomy. We present a case of an unusual MR imaging appearance of a large lumbar disk extrusion causing early CES.

Results: Multiplanar multisequence MR imaging of the lumbar spine on a male with severe acute on chronic back pain and bladder incontinence demonstrated a large anterior epidural mass mimicking a tumor or hematoma. Subsequent surgical pathology proved this lesion to be a unique presentation of a large extruded disk herniation. Correlation with histologic images and pathologic discussion will be presented.

Conclusion: Cauda equina syndrome is a clinical diagnosis that relies on cross-sectional imaging to explore the etiology of this medical emergency. Disk herniation is one of several possible sources for lumbosacral nerve root compression. It is important to recognize the possibility of nerve root compression, as early intervention is critical in the prognosis. This case illustrates an unusual MR imaging appearance of pathology-proven disk extrusion.

(E-57) Tuesday • 7:00 AM
Posterior Reversible Encephalopathy Syndrome: Etiology, Clinical Presentation, and Imaging Features

Jennifer N. Kucera, MD, MS, *University of South Florida, Tampa, FL*; Paul P. Byra, MD, BS; Carlos R. Martinez, MD; John M. Donatelli, MD (*jneville@health.usf.edu*)

LEARNING OBJECTIVES: 1. Describe the potential causes of posterior reversible encephalopathy syndrome (PRES). 2. Discuss the clinical presentations of PRES. 3. Describe the variable radiographic features of PRES.

CONTENT DESCRIPTION: I. Clinical conditions associated with PRES. II. Proposed pathophysiology of PRES. III. Clinical presentations of PRES. IV. Typical imaging features of PRES on CT and MRI. V. Atypical imaging features of PRES. VI. Processes that may mimic PRES on imaging studies. VII. Complications and potential long-term sequelae of PRES. VIII. Clinical management of PRES.

(E-58) Wednesday • 7:00 AM
CT Perfusion Imaging: A Practical Approach to Basic Concepts and Interpretation for 1st-Year Radiology Residents

Matthew Irwine, MD, *Ochsner Clinic Foundation, New Orleans, LA*; Cara Irwine, MD; James M. Milburn, MD; Gabriel Vidal, MD (*matt.irwine@gmail.com*)

LEARNING OBJECTIVES: 1. Understand the basics of CT perfusion components, specifically, mean transit time (MTT), cerebral blood flow (CBF), and cerebral blood volume (CBV). 2. Systematically analyze and interpret a perfusion study using the aforementioned components through case-based learning. 3. For caveats and pitfalls, explain commonly encountered issues, including anatomic and physiologic variants, as well as technical factors.

CONTENT DESCRIPTION: CT perfusion imaging is a powerful tool in the radiologist's armamentarium for evaluating acute ischemic strokes. Unlike conventional noncontrast CT imaging, CT perfusion imaging allows a radiologist to directly impact clinical outcomes by providing the ability to distinguish infarction from potentially salvageable penumbra. While clinically valuable, these studies can often be intimidating for the on-call radiologist, especially during the initial stages of residency training. This poster will provide a brief introduction to the components of CT perfusion imaging and a simple reproducible method for interpretation using case-based examples of commonly encountered scenarios.

(E-60) Wednesday • 7:00 AM
Radiologic Findings in Brain Death: An Adjunct to Clinical Diagnosis

Anne Marie Sullivan, BS, MD, *SUNY Upstate Medical University, Syracuse, NY*; Michele Lisi, MD; Kirk A. Craig, MD; Ross Sullivan, BS, MD (*adena@upstate.edu*)

LEARNING OBJECTIVES: 1. Identify the radiologic exams and the findings of these exams that can be used to support or refute the clinical diagnosis of brain death. 2. List the advantages and limitations of each exam. 3. Recognize the clinical scenarios in which these radiologic exams may be useful as an adjunct to clinical diagnosis. 4. Describe the clinical criteria for brain death.

CONTENT DESCRIPTION: I. Clinical criteria for brain death. II. Situations in which the clinician may request ancillary radiologic exams to confirm clinical findings. III. Review of imaging findings: conventional angiography, CTA, MRI/MRA, transcranial Doppler, and radionuclide brain perfusion. IV. Sample cases of findings that confirm brain death or refute brain death from each type of exam. V. Advantages and limitations of each exam. VI. Summary and future direction of these exams.

(E-61) Tuesday • 7:00 AM
Gulp: The On-Call Neck CT—A Brief Primer on a Good Dictation, Basic Anatomy, and Common Pathology

Eddy Morales, MD, *Beth Israel Medical Center, New York, NY;* George E. Lynskey III, MD; James E. Silberzweig, MD; Matthew G. Young, DO

LEARNING OBJECTIVES: 1. Identify the components of a good dictation of the neck. 2. Describe basic neck anatomy. 3. Describe common pathology and occasional pitfalls on neck CT, with associated dictation.

CONTENT DESCRIPTION: *Purpose/Introduction:* The typical resident now begins call after 12 months of training; however, the extent to which that training involves direct instruction on neck anatomy and pathology is limited. Nonetheless, young and old still come to the emergency department needing CT of the neck. This poster will demonstrate the components of a good dictation of the neck while reviewing the basic anatomy, common pathology, and occasional pitfalls when encountering this sometimes daunting study.

Content Organization: I. Brief overview of anatomic spaces of the neck and their contents, with CT correlation. II. Essential components of a good CT neck dictation. III. Overview of basic pathology seen on call, with associated dictation, including abscess vs phlegmon, neoplasm, and foreign body.

Conclusion: CT of the neck and the associated dictation are difficult for new on-call residents. This primer will allow them to review the basic anatomy, understand the essential components of a good dictation, and see these above goals in practice with several cases of basic but common pathology.

EDUCATION POSTERS

(E-64) Wednesday • 7:00 AM
Congenital Pediatric Cerebral Malformation: A Case-based Interactive Review

Asif Abdullah; Ahmad Aouthmany, MD, *University of Toledo, Toledo, OH*; Haitham Elsamaloty, MD

LEARNING OBJECTIVES: 1. Identify the common supra- and infra-tentorial congenital abnormalities. 2. Describe the indications for MR imaging and the appropriate imaging protocol. 3. Explain if and when CT is useful in the investigation of congenital anomalies.

CONTENT DESCRIPTION: Brain malformations are conditions where the brain has not formed properly during pregnancy. These problems in brain structure are most often, with few exceptions, associated with neurological and developmental problems. Often, brain malformations are part of syndromic complexes that require a multidisciplinary approach. Malformations may be caused by inherited genetic defects, spontaneous mutations within the genes of the embryo, or effects on the embryo due to maternal infection, trauma, or drug use. Classification schemes are currently shifting from a morphological to a genetic approach. The most frequent congenital brain abnormalities may be categorized into anomalies of the corpus callosum and telencephalic commissures, holoprosencephalies and related entities, malformations of the cerebral cortex, and malformations of the cerebellum. These congenital brain defects are diagnosed either by direct physical examination or by imaging studies, including CT and MRI. Prenatal MRI offers a viable method to improve detection and characterization of these entities in utero. A case-based interactive review of these malformations will be presented.

(E-67) Tuesday • 7:00 AM
Percutaneous Vertebroplasty: Techniques, Considerations, and Strategies

Jeffrey A. Walker, MD, *University of Texas Southwestern Medical Center, Dallas, TX*; Michael D. Richter, MD; David H. Uhrbrock, MD; David P. Chason, MD (*david.chason@utsouthwestern.edu*)

LEARNING OBJECTIVES: 1. Identify the pertinent bony and vascular anatomy. 2. Describe equipment selection, fluoroscopic positioning, needle approaches, and general techniques. 3. Predict risk and route of cement extravasation to optimize filling. 4. Describe concurrent biopsy methods. 5. Discuss difficult scenarios: vertebra plana, retropulsion, and tumor involvement.

CONTENT DESCRIPTION: Percutaneous vertebroplasty is a commonly used procedure for pain relief and/or stabilization of osteoporotic and pathologic vertebral body compression fractures. The high degree of variability in fracture morphology and tumor involvement presents technical challenges to the radiologist. This exhibit illustrates and discusses percutaneous vertebroplasty, with attention to anatomy, procedure planning, technique, and challenges.

(E-68) Wednesday • 7:00 AM
Enough to Make Your Head Hurt: A Review of Traumatic Mechanisms and Blunt Cerebrovascular Injuries

Sabina Amin, MD, *University of Texas Southwestern, Dallas, TX*; Erin Moody

LEARNING OBJECTIVES: 1. Understand and discern grades I–V blunt cerebrovascular injuries. 2. Describe the common mechanisms of injury that are seen in conjunction with carotid/vertebral artery injury, including high- or low-speed motor vehicle collision, hanging/strangulation, fall, penetrating injuries, and blunt trauma. 3. Identify common sequelae of traumatic mechanisms of injury, such as cervical spine, facial, and skull fractures and the association with arterial injury. 4. Describe risks of various injuries and common treatment options, including the need for emergent therapy.

CONTENT DESCRIPTION: Blunt cerebrovascular injuries are uncommon but potentially devastating injuries; thus, a high index of suspicion in at-risk patients and aggressive screening of multitrauma patients can lead to early diagnosis of asymptomatic lesions that may be amenable to treatment prior to the onset of ischemia. Due to its increasing availability and favorable risk profile compared to catheter angiography, multidetector CT angiography has become utilized at an exponential rate in the evaluation of trauma patients. The radiologist plays an essential role in the early diagnosis, follow-up, and, in some cases, treatment of these challenging injuries. The purpose of this exhibit is to educate residents about common mechanisms and patterns of traumatic injury, grading of vascular injury, and treatment options, including recognizing the necessity of urgent therapy.

(E-72) Wednesday • 7:00 AM
Abernethy Malformation: Imaging Features, Classification, and Management

Paul P. Byra, MD, BS, *University of South Florida, Tampa, FL*; Jennifer N. Kucera, MD, MS; Robert Heithaus

LEARNING OBJECTIVES: 1. Describe and demonstrate the imaging features of an Abernethy malformation. 2. Distinguish the classifications of extrahepatic portosystemic malformations. 3. Describe the potential complications of an extrahepatic portosystemic malformation. 4. Discuss the approach to managing patients with an Abernethy malformation.

CONTENT DESCRIPTION: I. Abernethy malformation description. II. Review of imaging findings on ultrasound and CT. III. Classifications of extrahepatic portosystemic malformations and clinical implications. IV. Complications of an extrahepatic portosystemic malformation. V. Management of an Abernethy malformation.

(E-73) Tuesday • 7:00 AM
Pediatric Cat-Scratch Disease from Head to Toe: A Pictorial Essay

Megan R. Saettele, MD, *University of Missouri-Kansas City/St. Luke's Hospital, Kansas City, MO*; John N. Morelli, MD; Suchit Patel, MD; Lisa H. Lowe, MD; Vikas Patel

LEARNING OBJECTIVES: 1. Identify the broad spectrum of pathology associated with cat-scratch disease. 2. Describe the most common imaging findings associated with cat-scratch disease.

CONTENT DESCRIPTION: Cat-scratch disease (CSD) is generally a benign and self-limiting condition but may imitate more serious diseases due to its variable imaging presentations. As many as 90% of the patients have an identifiable contact with a cat, usually in the form of a scratch or bite. This exhibit will review radiologic manifestations of cat-scratch disease, along with cases encountered at our institution demonstrating the highly variable imaging findings. The knowledge obtained from this exhibit will facilitate making this diagnosis in a noninvasive cost-effective manner in the appropriate clinical settings. Imaging findings with the disease, such as lymphadenopathy, hepatosplenic lesions, osteomyelitis/diskitis, encephalitis/meningitis, ophthalmitis, and cranial neuritis, will be illustrated and discussed.

★ Faculty financial disclosures are located in the Faculty Index.

(E-77) Tuesday ● 7:00 AM
BI-RADS® Classification and Clinical Significance of Breast Density

Tiffany Lewis, DO, MBA, *University of Kansas Medical Center, Kansas City, KS*; Onalisa Winblad, MD

LEARNING OBJECTIVES: 1. Review the BI-RADS® breast density classification system with correlating digital mammography images. 2. Explain the significance of the BI-RADS® density measurements and adjunctive imaging modalities for patients with dense breasts.

CONTENT DESCRIPTION: Breast density has been shown to increase breast cancer risk sixfold. Understanding the BI-RADS® breast density classification system, as well as alternative imaging approaches for patients with dense breasts, is essential for comprehensive evaluation of mammographic images.

Content Organization: I. Review of BI-RADS® breast density classification system with mammographic images. II. Calculating breast density: subjective versus automated. III. Adjunctive imaging for patients with dense breasts: automated or handheld breast ultrasound, breast MRI, and nuclear imaging. IV. Clinical significance of breast density and summary.

(E-78) Wednesday ● 7:00 AM
Uncommon Male Breast Lesions: Imaging Findings with Histopathologic Correlation

Bryan Foley, MD, *Texas Tech University Health Sciences Center, El Paso, TX*; Osvaldo Padilla, MD; Anoop Ayyappan, MD; Arvin E. Robinson, MD★

LEARNING OBJECTIVES: 1. Identify the broad spectrum of imaging findings of rare male breast lesions. 2. Describe contemporary clinical management guidelines.

CONTENT DESCRIPTION: Knowledge of the imaging appearances of rare male breast lesions diagnosed by core needle biopsy can help the radiologist decide whether the results of pathologic analysis concur with the imaging findings and, thereby, to recommend appropriate management. This educational exhibit aims to *(a)* illustrate mammographic and sonographic appearances of uncommon male breast lesions, *(b)* discuss the correlation of mammography and ultrasound features with pathologic findings, and *(c)* review current clinical management guidelines.

Content Organization: I. Introduction. II. Review of imaging appearances of uncommon male breast lesions such as spindle cell tumor, intracystic papillary malignancy, pseudoangiomatous stromal hyperplasia, etc. III. Radiologic-pathologic correlation. IV. Discuss specific imaging features that can narrow the differential diagnosis. V. Current management recommendations. VI. Summary.

(E-79) Tuesday ● 7:00 AM
Practical Approach to Interpreting the American College of Radiology National Mammography Database Report at the Physician Level

Alisa K. Johnson, BA, MD, *University of Wisconsin, Madison, WI*; L. Holman, BS; Gale A. Sisney, MD

LEARNING OBJECTIVES: To apply a practical approach to interpreting the American College of Radiology National Mammography Database (ACR-NMD) report by doing the following: 1. Learn appropriate statistical interpretation of data charts, percentile curves, histograms, and scatter maps. 2. Recognize patterns of specific physician reading trends, and facilitate comparisons among physicians, the NMD, and the Breast Cancer Surveillance Consortium. 3. Utilize frequency, percentile, and outcome trend metrics in order to identify potential for performing quality improvement initiatives.

CONTENT DESCRIPTION: *Purpose:* 1. Review the importance of the ACR-NMD database. 2. Assess the ACR-NMD report in summarized data tables, histograms, line charts, percentile curves, and scatter map format. 3. Explain the appropriate statistical interpretation of each of these formats utilizing the 1-year baseline and 1-year follow-up physician-level ACR-NMD data. 4. Offer an accurate analysis and application of the data summarized in the ACR-NMD outcome metrics.

Content: 1. Included on the poster will be a sample of an ACR-NMD database report. 2. Highlights from ACR-NMD data tables, histograms, line charts, percentile curves, and scatter map format will be shown. 3. Explanations will be provided for statistical conclusions. 4. Examples of accurate and inaccurate interpretations of the above data formats will be demonstrated.

Teaching Points: 1. ACR-NMD charts and graphs are a complex but powerful way of describing physician-level performance. 2. Physician outcome measures can be evaluated for performance against established benchmark data. 3. Accurate interpretation of the ACR-NMD informational graphics and data tables is vital in evaluating a physician's performance against a standard. 4. Root cause analysis of ACR-NMD data may identify performance quality improvement projects that will serve to improve patient care.

★ Faculty financial disclosures are located in the Faculty Index.

AUR 2012 Electronic Education Exhibit Abstracts

Electronic education exhibits will be displayed on Wednesday, March 21, 4:00–5:30 PM, and will be located in Cibolo Canyon Ballroom 5. *AMA PRA Category 1 Credit*™ will be awarded for attending this session. Presenting author is identified by institution name, city, and state (or country, if not United States or Canada). Presentations by trainees (residents, fellows, or 1st-year fellows) are noted in burnt orange.

AMSER Henry Goldberg Medical Student Award

(E-101)
Radiology ExamWeb: Development and Implementation of a National Web-based Examination System for Medical Students in Radiology

Dana J. Lin, BA, *Dartmouth Medical School, Hanover, NH*; Nancy J. McNulty, MD; Petra J. Lewis, MD⋆ *(petra.j.lewis@hitchcock.org)*

PURPOSE: Faculty have limited time and resources to develop effective and valid exams to evaluate students. Our aim was to develop a Web-based pool of standardized NBME-format peer-reviewed question items based on the AMSER National Curriculum and to create an exam deployment system optimized for this purpose.

METHOD AND MATERIALS: AMSER members submitted questions currently used for testing students at their institutions. A pool of 24 subspecialty editors edited each item to conform to recommendations of the National Board of Medical Examiners (NBME). Each item was rated on a difficulty scale of 1–5 and categorized by system, modality, organ, and etiology. Software was developed by using commercially available software *(www.ExamWeb.com)* with extensive modifications. Questions were uploaded, and student and instructor sites were developed. Students take exams online and receive their scores immediately, ± feedback. Item validation was performed on items deployed >30 times ($n = 475$), including difficulty level (P) and point biserial coefficient (rbi), with editing of poorly performing items. The AMSER National Medical Student Curriculum was correlated with question items to ensure adequate curriculum coverage.

RESULTS: Radiology ExamWeb is fully functional, with 80 institutions registered and 18 regularly using the system. A total of 900 questions are currently available, and 600 are in the editing process. Over 1500 students have taken exams since July 2009. Instructors can make courses, classes, and multiple exams; select questions manually or by using category filters; and modify "shared exams" made by another instructor. More than 200 shared exams are available, and a standardized "shelf" exam is being developed by AMSER using Radiology ExamWeb.

CONCLUSION: Radiology ExamWeb has provided medical student educators in radiology with a means to evaluate students in a systematic way, using a nationally edited, regularly reviewed Web-based exam tool. The AMSER Standardized Exam will be the first national radiology student exam, which will aid national recognition of radiology education and standardization of teaching. (This study was supported by grants from the Hudson Foundation and the RSNA Research and Education Foundation.) *(radiology.examweb.com)*

(E-102)
Case of the Week: A Method for Developing and Maintaining Medical Student Interest in Radiology

Ethan Smith, MD, *University of Michigan, Ann Arbor, MI*; William J. Weadock, MD⋆; Janet E. Bailey, MD; Katherine A. Klein, MD

PURPOSE: In order to expose medical students to radiology early in their medical school careers and to bolster interest in the specialty, we set out to develop an easy-to-use Web-based method to allow the students access to a clinically oriented radiology "Case of the Week."

METHOD AND MATERIALS: First- and 2nd-year medical students at our institution were invited to sign up for a radiology interest group (RIG) during a medical school–sponsored activity fair. MIRC® (Medical Imaging

Resource Center of the Radiological Society of North America) software was used to create and present a series of basic radiology teaching file cases. Members of the RIG receive an e-mail each week with a link to each case. Students are able to access and view the cases online through a password-protected medical school Web site. All cases are approached from a clinical perspective. Imaging findings are annotated to increase accessibility for medical students, with relevant imaging anatomy showcased. A group of interested 4th-year medical students assisted in creating the cases. The case content is organized to correspond to the 1st-year medical students' gross anatomy dissection schedule. A discussion forum was set up by the RIG faculty mentors to answer questions and receive feedback regarding the cases.

CONCLUSION: Through the use of easily accessible radiologic "cases of the week," each organized to be relevant to the students' concurrent units of study, we hope to expose medical students to radiology early in their careers and to encourage interest in radiology as a specialty.

(E-103)
TeamRads.com: A Longitudinal Radiology Education Web Site

James X. Chen, BS, *Johns Hopkins University, Baltimore, MD*; Christopher Long; Krishna Juluru, MD; Donna Magid, MD, MEd *(james.chen@jhmi.edu)*

INTRODUCTION: *TeamRads.com* is a radiology education Web site that acts as a central hub for longitudinal medical student education. Radiology content is integrated and reinforced as students transition from preclinical to clinical years.

METHOD AND MATERIALS: The site was developed using the Joomla 1.5 content management system (Open Source Matters, New York, NY) and Adobe Dreamweaver CS5 (Adobe Systems, San Jose, CA). Interactive content has expanded to include Medical Imaging Resource Center (MIRC®) files, Adobe Flash animations, and three-dimensional QuickTime Virtual Reality (QTVR) modules. Feedback was solicited from students via e-mail and formal surveys to ensure relevance and utility of content.

RESULTS: Since its implementation in August 2010, *TeamRads.com* has evolved to include modules and lectures for 1st-year gross anatomy and neuroanatomy courses, orientation to American College of Radiology Appropriateness Criteria® for 3rd-year students, integrated modules for basic clinical clerkships, a residency application guide, and links to external radiology resources. Surveys have indicated that the site facilitates reinforcement of knowledge by centralizing content from multiple courses and rotations and allowing for convenient access to content review. Development of teaching materials by medical students and residents has also contributed to improved relevance of materials to students in early stages of training. Site visitation statistics have indicated that 100% of students accessed site gross anatomy content, as compared to 41% of students prior to the establishment of a central Web portal. 87% of students found the site helpful in exam preparation, and 79% of students found the site to be of good or excellent levels of user-friendliness.

CONCLUSION: *TeamRads.com* continues to be refined incrementally through student feedback and advancements in Web site and content development tools. The goal of this exhibit is to illustrate the components and organizational strategies that have allowed for the successful implementation of this Web site as the foundation for a longitudinal radiology curriculum.

⋆ Faculty financial disclosures are located in the Faculty Index.

(E-104)
Using iTunes U Podcasts and PDFs for Teaching Radiology to Medical Students

Stefan Tigges, MD, *Emory Clinic, Atlanta, GA*; Jay Patel, MD *(stigges@emory.edu)*

Only about 25% of medical schools have a required radiology clinical clerkship, and many of those rotations last 2 weeks or less. Given the central role that imaging plays in disease diagnosis and management, students may need access to nonclassroom instruction to supplement their knowledge of radiology. At Emory University School of Medicine, our free-standing 2-week clerkship was eliminated and replaced with approximately 1 week of contact time distributed throughout the remaining clinical clerkships. To make up for this shortfall, we established a site on iTunes U to upload vital information for medical students on which they were tested. We created podcasts on the 22 AMSER "don't miss" diagnoses, uploaded podcast reviews on diagnostic testing and screening, and started an extra-credit case of the month. During the first 18 months, there were 6975 downloads, and students reported using the podcasts as their first choice to learn the 22 "don't miss" diagnoses. This electronic education exhibit will familiarize participants with how to construct a successful iTunesU site and the type of software necessary to create compelling podcasts and PDFs.

(E-105)
An Interactive PDF File for Teaching the High-Resolution CT Pulmonary Nodule Algorithm

Stefan Tigges, MD, *Emory Clinic, Atlanta, GA*; Travis S. Henry, MD★ *(stigges@emory.edu)*

Pulmonary nodules are a common finding on thoracic CT scans, with an extensive differential diagnosis. An algorithm has been developed using nodule distribution and morphology to anatomically localize nodules, putting nodules into one of four different categories, each with limited diagnostic possibilities. We have developed an interactive Portable Document Format (PDF; Adobe Systems) file that teaches residents to use this algorithm. The PDF file is written in graphic novel form, with an emphasis on the anatomic and pathologic basis for the algorithm. All concepts are explained visually, using line drawings, CT images, and pathologic specimens. Several embedded Flash (SWF; Adobe Systems) movies are included to reinforce difficult concepts. Finally, scrollable cases are included so that readers can test their knowledge of the algorithm. After viewing the interactive nodule PDF file, readers should be able to classify lung nodules and offer a brief differential diagnosis based on the nodule algorithm.

(E-106)
Core Signs and Findings in Thoracic Radiology

Travis S. Henry, MD★*, Emory University, Atlanta, GA*; Stefan Tigges, MD *(stigges@emory.edu)*

The chest x-ray is the most commonly obtained radiographic examination in the United States and, combined with chest CT, forms the foundation of pulmonary imaging. The American Board of Radiology (ABR) has identified approximately 50 thoracic imaging signs/findings that are core knowledge for radiologists and will be key components of the thoracic section in the ABR "exam of the future." This interactive exhibit will include definitions and examples of each of these 50 signs/findings. The pathophysiology, significance, and differential diagnosis of each sign will be included. Pitfalls will also be discussed. After completing the interactive "Core Signs and Findings in Thoracic Radiology" module, participants will be able to define, identify, and understand the significance of the signs/findings of thoracic disease listed in the American Board of Radiology's Core Exam Study Guide.

(E-107)
Audience Response Systems: Preparing for the "Exam of the Future"

Bryan Yi, MD, MPH*, Emory University Hospital, Atlanta, GA*; Ashley H. Aiken, MD; Bruce R. Baumgartner, MD

PURPOSE: Planning for examinations of the future is a challenge faced by programs across the country. The format is largely unknown but will likely contain more case-based multiple-choice questions (MCQs). Audience response systems (ARSs) represent an innovative approach to radiol-

ogy conferences to enhance learning, improve feedback to educators, and prepare residents for the new exam. The ARS will also be a valuable asset for addressing the ACGME core competencies.

METHOD AND MATERIALS: The Emory radiology residency program began implementation of a Web-based ARS where residents across multiple sites respond with their own "smart" devices. Target faculty and audience members were approached based on who would be most enthusiastic to incorporate interactive lectures into the curriculum. A fully interactive beta lecture was given to the target audience, with the opportunity for faculty observation. Feedback was obtained after the lecture, as this remains an ongoing project within the department.

RESULTS: Response to the beta lecture was overwhelmingly positive, with 100% participation among the target audience. Feedback favored a format that mixes MCQs with a traditional oral case conference. Specifically, there were two types of cases. The first type involved a resident discussing a case in the conventional fashion to arrive at a diagnosis, with follow-up MCQs given to the entire audience. The second type of case provided image-based MCQs, with the initial question asking for a diagnosis from the entire audience. Follow-up questions revolved around concepts tested by the in-service exams. We plan to expand the competency coverage from this model to include clinical vignettes that could assess professionalism and communication and interpersonal skills. Finally, the recording of individual responses is being investigated. This would be beneficial, as it offers a valuable metric to measure resident performance.

CONCLUSION: Interactive lectures with audience participation are a valuable way to approach residency education. This is a natural extension of what already occurs at major radiology conferences. We are embracing this as a way of improving resident education.

(E-108)
Improved Installation and Function of the RSNA's MIRC® Radiology Teaching File System

William J. Weadock, MD★*, University of Michigan Hospital, Ann Arbor, MI*; Adam Flanders, MD★ *(weadock@umich.edu)*

Over the past 10 years, there has been continued development of the RSNA's Medical Imaging Resource Center (MIRC®) teaching file system. In the past year, there has been a significant improvement in the ease of installation and function of the program. This exhibit will demonstrate the ease of installation and use of MIRC®. Radiology teaching files can include text, images, videos, and other files. Each of these file types can be presented in an interactive manner by using MIRC®. MIRC® can be set up on a personal computer (PC) for individual use or can also be set up for use across a group of individuals, with access restricted by username and password. Images can be sent directly to the system, either as DICOM images or added to the system as JPEG (.jpg) or other types of image files. For those who have previously created a hierarchical folder structure of interesting cases with images on their PC, there is also an option to import the entire group of folders into MIRC®, resulting in a separate teaching file case for each folder. There is a built-in authoring tool, which allows the user to add textual information such as history, findings, diagnosis, etc. Finally, cases can be searched by using a free text query or filtered by subspecialty, anatomy, etc. The MIRC® program is supported by RSNA and can be freely downloaded and installed.

(E-109)
Digital Programmed Learning Module to Teach Basic Interpretation of Head CT

Daniel Barr, MD, *University of Michigan, Ann Arbor, MI*; Kara G. Udager, MD; Bradley R. Foerster, MD; Hemant A. Parmar, MD; Janet E. Bailey, MD; Jeffrey R. Wesolowski, MD; et al *(danbarr@med.umich.edu)*

Programmed learning is a concept initially developed by behavioral psychologist B. F. Skinner in 1958 and is characterized by several key elements, including *(a)* self-paced study, *(b)* information delivery in small increments, and *(c)* immediate application of acquired information with positive and negative feedback. Two classic examples with which most of us are familiar are Dubin's *Rapid Interpretation of EKG's* and Goodman's *Felson's Principles of Chest Roentgenology*. Adaptation of these techniques to computer-based systems led to the development of teaching tools ranging from basic reading applications to highly complex military simulators, all referred to as "integrated learning systems" (ILSs). In addition

to the programmed learning format, an ILS offers several advantages over traditional text or lecture formats for teaching radiology. Among the most important, an ILS can allow learners to view and interact with images as they might during the workday (eg, scroll through an entire computed tomography [CT] or magnetic resonance study, change window width and level, etc), thus taking advantage of "near transfer," the theory that information learned in one environment can be better applied to another environment if the two environments are similar. Therefore, a well-designed ILS not only promotes the acquisition of knowledge through programmed learning but also promotes the application of knowledge during clinical practice via "near transfer." In this exhibit, we present a basic ILS developed to teach new residents a systematic approach to noncontrast head CT interpretation, as well as several common pathologies. Conference attendees will be able to use the software in the same interactive fashion as the trainees for whom it was designed.

(E-110)
Radiology Protocol Web Site: A Resident Resource

Jon Loo, MD, *University of Minnesota, Minneapolis, MN (Looxx015@umn.edu)*

INTRODUCTION: At our institution, radiology protocols are typically selected by radiology residents. A large number of protocols are selected by 1st-year residents, who have limited protocoling experience. Suboptimal protocol selection is not uncommon and may ultimately lead to misdiagnosis due to a suboptimal imaging study. The patient may need to return to the department in order to complete the proper study, leading to increased cost, increased patient radiation, and patient dissatisfaction.

BACKGROUND: Radiology residents were tested on their protocoling ability. Residents were presented with 10 commonly encountered clinical indications for chest CT. Percentages protocoled correctly were as follows (residents are divided by year in residency; numbers of surveys returned are in parentheses): R1 (10), 36%; R2 (6), 68%; R3 (4), 80%; and R4 (5), 85%. Based on these results, it was determined that a protocoling resource may enhance resident understanding and increase protocoling accuracy. Therefore a Web site was created, listing various clinical indications for chest and abdomen CT and their corresponding protocols. Some examples of featured clinical indications for chest CT include hemoptysis, ILD, cystic fibrosis, empyema, pulmonary AVM, pulmonary nodule, shortness of breath, and trauma.

CONCLUSION: The Web site currently includes approximately 40 indications for chest and abdomen CT and their corresponding protocols. Each protocol includes rationale for the phases of each scan if applicable, utility of contrast, ACR Appropriateness Criteria® if available, and useful diagrams or grading schemes. The Web site is constantly updated as new clinical indications for CT are encountered during daily practice.

(E-111)
On the Clock: The Benefits and Consequences of Tracking Resident Emergency Department Turnaround Time

Stacey O. Verzosa, MD, *Beth Israel Medical Center, New York, NY*; James E. Silberzweig, MD

PURPOSE: Turnaround time (TAT) for ED radiology reports is a parameter used by many radiology programs. The purpose of this study is to survey radiology residents and program directors as to whether or not TAT is tracked and, if so, to what extent. Understanding resident attitudes toward report tracking may help guide programs to provide optimal resident training and efficient patient care.

METHOD AND MATERIALS: Surveys were distributed by e-mail to be completed by the APDR membership, with a request for a similar survey to be forwarded to their current residents. Questions included whether TAT is tracked, how it is tracked, target turnaround time, data utilization, and stress and fatigue related to tracking TAT.

RESULTS: Sixty-three program directors responded. 60% of departments tracked TAT for resident preliminary ED reports. 54% indicated that TAT is an accurate measure of resident efficiency, 26% were neutral, and 21% disagreed. 56% agreed that TAT tracking contributes to significant resident stress, 20% were neutral, and 25% disagreed. 69% agreed that tracking TAT is an effective way of preparing residents for the real world, 18% were neutral, and 15% disagreed. 47% agreed that TAT is a reasonable method of resident evaluation, 28% were neutral, and 26% disagreed. One

hundred eighty residents responded. 27% of residents agreed that TAT is an accurate measure of resident efficiency, 26% were neutral, and 47% disagreed. 53% of residents felt that knowing that TAT is being tracked contributes to significant stress on call, 31% were neutral, and 17% disagreed. 42% agreed that tracking TAT contributes to fatigue while on call, 38% were neutral, and 19% disagreed.

CONCLUSION: Most programs track ED radiology report turnaround time. Although tracking turnaround time is commonly considered a good method to evaluate resident efficiency and preparation for practice beyond residency, tracking of turnaround time contributes to added stress.

(E-112)
Discrepancy Logger/Resident Call Simulator: A System to Augment Resident Call Education

Richard J. Gorniak, MD★; Richard E. Sharpe, Jr, MD, MBA, *Thomas Jefferson University, Philadelphia, PA*; Ronald S. Winokur, MD; Levon N. Nazarian, MD; Paras Lakhani, MD; Adam Flanders, MD★; et al

A two-part system, consisting of the Discrepancy Logger (DL) and the Resident Call Simulator (RCS), was developed to augment resident education in the on-call setting. The DL is a locally developed PACS plug-in that enables attending radiologists to log errors in overnight ER radiology reports and e-mail the resident who generated the report from within the PACS application. This is especially useful when the attending performing the final read is in a location separate from the resident, allowing the attending to give feedback to the overnight resident via informal teaching points in an e-mail separate from the patient's record. As the DL is integrated into the PACS application, it is quick and easy for the attending to use. The second part of the system, the RCS, uses the cases entered in the DL where the on-call resident made an error as the basis for a teaching file. However, unlike a typical teaching file, an anonymized version of the entire DICOM data set of the case is used. The RCS is hosted on a nonclinical PACS test server which uses the same user interface as the clinical PACS. With this system, the resident has to evaluate the entire set of patient images, similar to actually reading the case, to detect the findings that the resident previously missed while on call. A custom worklist-like interface allows the resident to select cases and see anonymized final reports/attending DL comments and track their progress. There are over 240 cases in the simulator, ranging from missed fractures and subdural hemorrhages to incidental pulmonary and thyroid nodules. The DL/RCS system is a useful tool for resident call education that provides individual feedback and allows all residents to learn from real-world errors made by their fellow residents.

(E-113)
Training Residents to Recognize and Treat Intravenous Contrast Reactions by Using the iPad as a Virtual Simulation Lab

Susan Summerton, MD★, *Albert Einstein Medical Center, Philadelphia, PA*; Huyen Tran, MD; Ryan Smith, MD; Jill Gluskin, MD; Jonathan Hill; William Herring, MD *(summertons@einstein.edu)*

PURPOSE: The purpose is to improve resident competence in recognizing and treating contrast reactions through multiple training repetitions. We have been able to utilize the iPad as a virtual simulation lab. Using the *ACR Manual on Contrast Media,* we analyzed the core competencies needed to address management of contrast reactions. We devised a virtual simulation lab using two iPads. Training can remain in the radiology department, obviating the need to have faculty members and residents spend an inordinate amount of time outside of the radiology department in the sim lab for training. Residents can continue training until they reach competence and confidence. The resident uses the iPad student edition, loaded with the scenario, photos, and audio of the virtual patient with vital signs, ECG tracings, breath sounds, etc. The teacher uses the iPad teacher edition, loaded with the core competencies checklist, algorithmic flowcharts, and tables of pharmaceutical doses. The resident and teacher go through scenarios using a volunteer resident acting as a virtual patient.

RESULTS: The iPad virtual simulation lab can be used to train radiology residents to recognize and treat contrast reactions.

CONCLUSION: We will bring an iPad to demonstrate how we have used it in training our residents to handle contrast reactions. *(www.learningradiology.com/virtualsimlab)*

★ Faculty financial disclosures are located in the Faculty Index.

(E-114)
Enhancing Trainee Education with a Departmental Digital Lecture Library

Adam Flanders, MD★; Richard E. Sharpe, Jr, MD, MBA, *Thomas Jefferson University, Philadelphia, PA*; Ronald S. Winokur, MD; Richard J. Gorniak, MD★; Paras Lakhani, MD; Levon N. Nazarian, MD; et al

INTRODUCTION: A valuable component of a resident curriculum is achieved through live didactic teaching, which may comprise approximately 1–2 hours of the trainee's clinical day. Time constraints in the trainee schedule (particularly for non-ACGME fellows) can present challenges in attending all lectures. There is a need to provide a simple and reliable method to capture this lecture material and make it consumable at a time of the trainee's own choosing. We have developed a perpetual online library of didactic lectures coupled to a browsable database for use by all trainees and attendings.

DESIGN AND IMPLEMENTATION: Our digital lecture library (DLL) was designed to be minimally disruptive to the lecturer and audience. It incorporates a screen/audio capture application (Camtasia; TechSmith Inc), which is embedded in the PowerPoint program running on the lectern PC. Upon completion of each lecture, the file is processed into Adobe Flash/Shockwave format for streaming, and the file is moved to a dropbox for processing. An open-source, custom management, file server, Web server application was developed to register each lecture into a database (MySQL) using server-sided scripts and JavaScript. Registered users can then browse lectures from any networked computer. The program also records usage statistics: number of lecture views, total view time, and viewer identity. Program directors and lecturers themselves can then use this information to determine which lectures seem to be most popular and potentially revise curriculum to meet these needs.

EVALUATION: In the 2.5 years since its inception, the DLL has amassed over 470 lectures. The largest category represented is musculoskeletal, followed by body MRI, ultrasound, and neuroradiology. There are 268 registered users (93 residents, 55 fellows, 44 students, and 41 attendings). Over 3060 unique lecture viewings have been logged. The most popular lectures are musculoskeletal.

CONCLUSION: Preserving didactic educational material has many potential advantages to augment trainee education. It promotes self-study and off-hours learning opportunities that otherwise would not be available.

(E-115)
Report Comparator Software Identifies and Displays Changes That Attending Radiologists Make to Trainee Preliminary Reports

Richard E. Sharpe, Jr, MD, MBA, *Thomas Jefferson University, Philadelphia, PA*; Ronald S. Winokur, MD; Richard J. Gorniak, MD★; Levon N. Nazarian, MD; Vijay M. Rao, MD; Adam Flanders, MD★ *(Richsharpejr@gmail.com)*

BACKGROUND: Attending radiologists working in academic radiology departments routinely edit radiology reports drafted by radiology residents and fellows. It can be cumbersome for attending radiologists to recall specific edits that they make during the report finalization process and to relay these teaching points to trainees. To recover these valuable latent teaching points and communicate them to trainees, we created an electronic solution called the Report Comparator. We created a server-sided script on an independent server that extracts preliminary and final radiology reports, as well as report metadata. These data are stored in a MySQL database indexed by accession number, identity of trainees, and attending radiologists. A Web application allows trainees to view their 100 most recent preliminary and final report pairs, both side by side and in a "track changes" mode.

EVALUATION: Report Comparator utilization analysis demonstrated, over an 8-month period, that there were 993 distinct Report Comparator log-ins by 65 distinct trainees. Surveyed trainees stated that they compared reports for educational value and to improve future reports and patient care. Trainees stated that they compared reports more frequently after deployment of this software solution and that regular assessment of their work using the Report Comparator allowed them to routinely improve future report quality and improved radiological understanding.

CONCLUSION: In an era with increasing workload demands, trainee work-hour restrictions, and decentralization of department resources (eg, faculty, PACS), implementation of an electronic Report Comparator solution extracts available data and presents the data to trainees in an efficient and easy-to-use fashion. In doing so, the software recovers an important part of the radiology education experience that could have otherwise run the risk of being lost. Trainees routinely use this software, without it being required, and feel the application positively contributes to their report quality and educational experience.

(E-116)
Resident-Attending Communication Improved by a PACS-integrated Feedback System

Ronald S. Winokur, MD; Richard E. Sharpe, Jr, MD, MBA, *Thomas Jefferson University, Philadelphia, PA*; Richard J. Gorniak, MD★; Levon N. Nazarian, MD; Vijay M. Rao, MD; Adam Flanders, MD★

BACKGROUND: Diagnostic radiology trainees independently review imaging examinations and issue preliminary reports that are reviewed, and possibly edited, by attending radiologists during report finalization. Previously, these after-hours and call examinations would be jointly reviewed, often in the morning, between attending and trainee radiologists. However, numerous recent changes within medical education have challenged the institution of joint trainee and attending radiologist examination review. In the absence of face-to-face image review, the attending radiologist may not be able to provide trainees with detailed feedback regarding independent interpretations.

INTERVENTION: Realizing that resident education requires effective feedback, we created an electronic PACS-integrated solution to improve direct trainee and attending radiologist communication. This tool allows attending radiologists to directly e-mail interpreting trainee radiologists and, in an easy and timely fashion, send trainees positive, neutral, and negative feedback. By clicking a button from within PACS during report finalization, attending radiologists can send a free text message via e-mail to the appropriate interpreting trainee radiologist. Additionally, each message can be categorized as either "Good job, nice catch," "FYI," "Report Critique," or "Discrepancy." Discrepancies are logged by using previously established categories.

EVALUATION: One radiology division at our institution formally adopted the electronic feedback system as its primary mechanism of providing feedback to trainees for call cases lacking joint trainee and attending image review. Over 2000 feedback entries were logged in 8 months. Trainees report that the system allows them to efficiently receive feedback and that they look back at cases when they receive significant feedback messages.

CONCLUSION: Teaching points potentially lost by eliminating joint attending and trainee radiologist image review can be recovered by a PACS-based quick and easy-to-use electronic feedback logger.

(E-117)
Building an Online Videoconference Library for Resident Education

Stamatis Kantartzis, MD, *University of Pittsburgh Medical Center, Pittsburgh, PA*; Yun R. Sheu, MD; Philip D. Orons, DO *(kantsn@upmc.edu)*

PURPOSE: The Accreditation Council for Graduate Medical Education (ACGME) requires that residency programs provide at least 5 hours of educational conferences weekly. To meet the minimum ACGME requirements, each program generates at least 250 hours of conferences yearly. This volume of educational material is both enormous and fleeting, as the conferences are generally not repeated until the curriculum, often 2 years long, is complete. Residents who are on an overnight rotation, post-call, or on vacation thus lose a valuable educational opportunity; those who wish to review lectures at their own pace are unfortunately not able to do so. Recognizing the benefit that anytime-anywhere access to conferences would be for residents, our program began systematically archiving the majority of conferences online. The purpose of this electronic educational exhibit is to share the challenges and successes of this project.

CONTENT ORGANIZATION: The physical and technical requirements will be discussed, and alternatives to the solutions that we use will be compared as we detail our approach. The interactive portion of the exhibit will allow visitors to explore our online videoconference library firsthand using a test account. Specifically, conference audio and video are recorded using the native capabilities of the commercial videoconferencing software that we use to broadcast to our participating sites (GoToMeeting®; Citrix Systems, Fort Lauderdale, FL). After being screened for protected health information,

the video files are uploaded to a server, where a video sharing script (Clip-Bucket; Arslan Hassan) converts them to Flash video and indexes them for viewing across a variety of Internet-capable devices. A password-protected account is created for each trainee, allowing them to bookmark favorite lectures, upload comments, and be alerted about updates.

CONCLUSION: Online archiving of didactic conferences is an inexpensive and simple way to build a valuable educational asset, allowing easy access and review by residents and fellows alike.

(E-118)
Neuroradiology-Neurosurgery-Neuropathology Multidisciplinary Conference: A Unique Resident Educational Opportunity

Ben Kotinsley, *Allegheny General Hospital-Western Pennsylvania Hospital, Pittsburgh, PA*; Michael F. Goldberg, MD *(bkotinsl@wpahs.org)*

PURPOSE: The purpose is to describe the features and resident opinions of a unique subspecialized multidisciplinary conference among the radiology, neurosurgery, and pathology departments. The conference is designed primarily for resident education across specialties, in contradistinction to traditional multidisciplinary conferences oriented toward subsequent patient treatment options.

METHOD AND MATERIALS: Once per month, the residents and attending physicians from the departments of radiology, neurosurgery, and pathology hold a 1-hour conference to present and discuss interesting neurological cases. Residents from each discipline first present clinical information, radiographic imaging, and pathologic findings. The attending physicians then lead in-depth discussion regarding varying diagnostic options or appearances of the disease process, differential diagnosis, and management options. Examples of cases include trigeminal nerve schwannoma and intraosseous meningioma. Residents from each participating specialty were given a questionnaire to ascertain resident attitudes about the quality and value of education received at the conference. Additional questions were posed to the neurosurgery and pathology residents to learn if and how the presence of radiology residents affects their education and impression of the radiology department. We will create an electronic presentation showing the highlights and future directions of the conference.

RESULTS: Residents responded favorably to this format of conference as an educational experience. The majority of residents agreed that this style of conference fosters well-rounded physicians. Interestingly, while the radiology residents generally felt their presence added value to the conference, the neurosurgery and pathology residents collectively valued radiology's presence to a greater degree. While the neurosurgery residents preferred this style of conference to traditional didactic lectures, the radiology and pathology residents did not.

CONCLUSION: Active resident participation in a subspecialized multidisciplinary teaching conference can be a valuable adjunct to a traditional didactic curriculum.

(E-119)
Radiology Education and Testing Using Anonymized Studies

Ted Chang, MD*;* Peter Petruzzi, MD; Kathleen T. Hudson, MD; Brian Dupree; Amanda Ingram, MD, *University of Tennessee Medical Center-Knoxville, Knoxville, TN (tchang@utmck.edu)*

This exhibit demonstrates the use of case-based testing using a PACS system to bridge didactic lectures and workplace learning. An initial series of didactic lectures on liver MRI, beginning with an introduction to MRI sequences, lesion detection, and lesion identification, was given by a body fellowship–trained attending. Using the PACS database, a series of 24 pathology-proven liver lesion cases were selected and then anonymized. Patient name, medical record number, study date, and PACS ID were all removed so that the oringinal findings and dictations could not be viewed. Residents were then given a period of 2 weeks to review the cases on their routine PACS workstations and submit their preliminary findings and incidental findings via an online Adobe form that aggregated the submissions into an online database, accessible to the administering attendings. At the completion of the project, the cases were reviewed by the faculty in a con-

ference. Differential diagnosis and mangement were discussed. All cases had radiology-pathology correlation. An IRB exemption was obtained prior to the start of this project.

(E-120)
A Novel Method of Preparing Radiology Residents for After-hours Call

Brian Dontchos, MD*, University of Washington, Seattle, WA*; Michael F. McNeeley, MD; Sherwin S. Chan, MD, PhD; Francisco A. Perez, MD, PhD; Angelisa M. Paladin, MD *(dontchos@uw.edu)*

INTRODUCTION: Various methods of preparing radiology residents for after-hours call have been implemented, including oral examinations and objective structured clinical examinations (OSCEs). However, there are no published practical examinations that closely simulate the call environment. The aim of this study is to present a novel method of preparing 1st-year radiology residents to take after-hours call.

METHOD AND MATERIALS: Ten radiology residents from the University of Washington Medical Center (UWMC) and three radiology residents from Virginia Mason Medical Center (VMMC) were recruited. All residents were in their 1st year of radiology training (PGY-2), with approximately 11 months of radiology experience. Twelve cross-sectional and 12 plain film cases were selected from an on-call teaching file amassed by the 2nd-year (PGY-3) radiology class over the preceding 11 months. Final interpretations of the cases were made by attending radiologists (four of 24 cases were normal). The studies were loaded into a shared PACS worklist, and a time limit of 180 minutes was established. Working from individual PACS workstations, the examinees reviewed each case and submitted their written impressions. Test reviewers were blinded to the examinees' identities to prevent bias. Impressions were scored as correct or incorrect, based on the appropriate interpretation of the principal findings. An additional category was created for impressions in which the principal diagnosis was correct but secondary findings were missed or misinterpreted.

RESULTS/DISCUSSION: Overall group accuracy was 78%, with 199 true-positive and 44 true-negative interpretations. Additionally, there were 36 interpretations (12%) that were essentially accurate but with minor discrepancies. There were five false-positive and 27 false-negative interpretations (10%). Following the examination, the residents were given access to the entire on-call teaching file, including an index of cases by diagnosis, thereby allowing targeted self-study.

SUMMARY: We describe a practical and instructive tool for evaluating the readiness of radiology residents to function independently during after-hours call.

(E-121)
Effective Web Site Design for Improving Residency Program Communication

Nathan M. Cross, MD, *University of Washington, Seattle, WA*; Michael F. McNeeley, MD; Francisco A. Perez, MD, PhD *(fperez@uw.edu)*

Residency program communication can be challenging, particularly in a large program distributed across multiple sites of practice. Building a resident-specific Web site can facilitate the dissemination of program news and policies, the management of electronic educational resources, and the organization of residency contacts and calendars. Additionally, an integrated message board can provide a forum for peer mentorship and allow residents to create handbooks and other program documents collaboratively. The success of a resident Web site requires active participation, which itself is driven by providing useful information in an interactive, intuitive, and timely manner. At the same time, sustainable Web site development must be simple and inexpensive. WordPress is a free open-source software platform that provides a variety of built-in and extensible tools for creating, publishing, and managing online content. A live resident Web site implemented at the University of Washington using WordPress is presented, along with a discussion of the Web site's strengths, weaknesses, and future directions. Instructions for building similar resident Web sites at other programs are provided.

(E-122)
A Radiology Residency Portal with Resident Portfolio and Residency Program Document Management Systems

Richard Lee*, University of Southern California Keck School of Medicine, Los Angeles, CA*; Shane Slater; M. Victoria Marx, MD *(shanesla@med .usc.edu)*

Residency coordinators currently manage a substantial number of tasks for a residency program. The more time-consuming elements include resident portfolio and residency program–related document management, as well as communicating important events, deadlines, daily schedules, and tasks to both faculty and house staff. We present our prototype Web portal that addresses these two broad categories of perpetual labor. Specifically, our portal empowers each member of the house staff to take control of his or her own professional portfolio by managing the contents directly, preparing the resident for the career-long task of managing his or her own credentialing. This approach lends transparency to the contents of the portfolios and off-loads the burden of handling hundreds of paper folders from the shoulders of the coordinator and onto the individual shoulders of each member of the house staff. As important, the electronic folders are organized in an ACGME-compliant hierarchy, facilitating site visits and other audits. We further provide an online calendar linked to lectures and didactics, which are further linked to an evaluation system by which house staff may provide anonymous feedback and which obviates the need for paper-based collation of data. Lastly, we provide a central repository for residency program–related policies and other material, easily updated as needed and accessible to all associates of the residency program.

(E-123)
The Electronic Paper Poster: The American Society of Emergency Radiology Meeting Experience

Katherine A. Klein, MD, *University of Michigan, Ann Arbor, MI*; Steve Hatem, MD; Sarah C. Abate, BS; Aaron Sodickson; William J. Weadock, MD★

An increasing number of radiology society meetings have converted traditional paper poster exhibits to a multislide electronic format. This presents a quandary for meetings: Surveys have shown authors favor electronic formats. Authors save costs (printed posters cost $100–$400), avoid the inconvenience of carrying a printed poster, and can present much greater content. Viewers' criticisms have centered on the loss of collegial discussions during poster reviews and the challenges of perusing many exhibits quickly. An innovative solution was introduced as a pilot program at the 2011 ASER Annual Meeting: A single-slide electronic poster format was created to allow viewing of the entire poster on a large monitor, analogous to the traditional paper poster. The goal of this exhibit is to demonstrate the ASER electronic poster effort and to discuss the successes and failures from the ASER meeting experience. Abstracts were solicited with a description of the new poster format, a sample single-slide PowerPoint poster template, and format/font size guidelines. After the acceptances were disbursed, detailed instructions were e-mailed to all first authors. A deadline of 6 weeks prior to the meeting was given for premeeting review of content and compliance. The final resulting posters were converted to a PowerPoint(.pptx) format and loaded onto seven PCs connected to 50-inch plasma monitors placed in both the meeting foyer and a more private viewing room. Attendees were then able to select and review any of the posters on each monitor. Presenting author sessions were organized to allow more detailed interaction. Comments related to the new poster format were compiled from conference attendee surveys. Overall failures and pitfalls included lack of adherence to font guidelines, monitor resolution, monitor type, and minor instruction errors. By sharing what we have learned during this electronic poster pilot, we hope to encourage others to further explore novel methods of solving the author/viewer exhibit quandary.

(E-124)
Developing and Providing Case-based Online Radiology Education to a National and International Audience

Petra J. Lewis, MD★, *Dartmouth-Hitchcock Medical Center, Lebanon, NH*; Laura L. Avery, MD; Carl R. Fuhrman, MD; Erin E. O'Connor, MD; Sravanthi Reddy, MD *(petra.lewis@hitchcock.org)*

INTRODUCTION: Case-based education has been adopted by many medical schools over the last decade. Dartmouth has utilized case-based online radiology education (CORE) since 2006 in clinical clerkships. Recently, we introduced the system to a national audience by partnering with MedU *(www.med-u.org)* from iInTIME, a not-for-profit organization that develops Web-based medical student education.

METHOD AND MATERIALS: The AMSER curriculum was used as the foundation for case development. Cases include a realistic clinical scenario, images, questions, and hyperlinks through the same CASUS® software as MedU uses for case-based internal and family medicine and pediatric curricula. An editorial board of five AMSER members was established and contracted with MedU. The board extensively reviewed and updated 15 cases. A total of 550 Dartmouth student evaluations were collated and included in changes. Copyrighted data were removed, permissions obtained, and links to outside resources revised. An evaluation card was added. The AMSER curriculum was transformed into a spreadsheet and cross-correlated with case content. Case updates and marketing were handled by MedU through their subscriber list of 130 medical schools in the United States and Canada. Medical schools subscribe (at a fee) to individual or multiple MedU modules.

RESULTS: The case series has been available since July 2011. Thirteen medical schools have subscribed to the series to date; 496 students have used 1685 cases. The feedback has been generally very positive, although specific cases have been identified for improvement and are being revised. Curriculum correlation showed that about 80% of the AMSER curriculum is covered and has allowed us to plan adding "missing" topics to current and future cases.

SUMMARY: CORE was already established at Dartmouth as an effective means of providing a case-based educational format for radiology for students. By partnering with MedU, we have not only developed a means for disseminating the cases, but enabled software and server support, regular case update and maintenance, and integration with other clinical clerkship case series. Future projects include providing assessment and other instructor tools, as well as increasing subscriptions. *(http://med-u.org)*

(E-125)
Customized Online Multimedia Consent Forms for Interventional Radiology Procedures

Yun R. Sheu, MD, *University of Pittsburgh Medical Center, Pittsburgh, PA*; Stamatis Kantartzis, MD; Philip D. Orons, DO *(sheuy@upmc.edu)*

RATIONALE AND OBJECTIVES: Current universal paper-based consent forms do not provide enough information to a patient. The purpose of this project was to increase patient knowledge and understanding of interventional procedures through the use of customized online multimedia consent forms. These would take advantage of widely used smart phones and tablet computers for easy access by the consent-seeking physician and allow the incorporation of pictures and animations to supplement the traditional oral description of a procedure. During a consent, a step-by-step pictorial of the procedure is shown to the patient, and specific points of a procedure and pertinent risks (for example, encephalopathy with a TIPS) would have individual approval boxes which the patient would then need to check to indicate understanding and agreement.

CONTENT ORGANIZATION: I. Explanation and demonstration of an online consent supplementation system developed at our institution. II. Explanation of the various issues and troubleshooting that came up during development (ie, software used, optimal user interface, privacy issues, and equipment choice). III. Effects on patient satisfaction and understanding.

CONCLUSION: A standard all-encompassing paper consent form lacks the standardization and customization required to make sure all of the risks of a procedure are correctly relayed to a patient and relies too much on the oral description by the consent-seeking resident. While not a complete substitution for traditional paper forms, online customized consent forms with illustrations and bulleted points will increase patient understanding and decrease miscommunication and are easily accessible on commonly used mobile electronic devices.