



Zachary Clark

Radiology Research Symposium

**UNIVERSITY OF WISCONSIN
DEPARTMENT OF RADIOLOGY**

Virtual

April 29, 2021



Zachary Clark, MD, MS

The University of Wisconsin Department of Radiology annual research symposium is dedicated to the memory of Zachary Clark MS, MD. As an undergraduate student Dr. Clark developed an interest in Neurobiology and graduated from the University of Wisconsin with Distinction (Cum Laude). He earned a Master's degree in Neurobiology at Northwestern University and enrolled in the Research Honors program at the University of Wisconsin School of Medicine and Public Health the following year.

After completion of his internship in Internal Medicine, Dr. Clark entered the University of Wisconsin residency program. Zach, as his friends knew him, excelled during his residency and was loved by all. Although he was a serious, dedicated physician, he also possessed a great sense of humor and a contagious laugh.

During his second year of residency he expressed a strong interest in radiology research. His background in neuroscience made him a natural for Neuroradiology and he decided to focus his research on cerebrovascular diseases. His initial work on dural arteriovenous fistulas resulted in three national presentations and a publication in which he was the primary author. Subsequently, Dr. Clark authored or co-authored six abstracts, two publications and three scientific exhibits, one of which receive the Magna Cum Laude award from the Radiology Society of North America. His first funding proposal describing a novel method to image both the cerebrovasculature and brain perfusion using arterial spin labelling was submitted to the "RSNA Resident Research Grant" competition. In his personal statement for the application Zach shared a bit of his personal philosophy - "my long-term career goal is to advance the field of Radiology and to serve our patients by reducing the pain and suffering related to stroke and other cerebrovascular diseases."

In the spirit of his passion for research we dedicate this symposium to Dr. Zachary Clark who truly embodied the concept of the clinician researcher. He is greatly missed by all.

2021 Presenters

Oral Presenters

Trainee Level

Allison Couillard, MD	PGY2 Diagnostic Resident
Edward Lawrence, MD	Abdominal Imaging Fellow
Nancy Ann Little, MD	PGY2 Diagnostic Resident
Petra Lovrec, MD	Molecular Imaging/PET Fellow
Albert Perez, MS4	Medical Student 4
John Swietlik, MD	PGY6 IR-Integrated Resident
Charles Viers, MD	PGY3 Diagnostic Resident
Andrew Wentland, MD, PhD	Abdominal Imaging Fellow

Electronic Exhibits

Trainee Level

Submission Type

Abdul Abdelazim, MD	Abdominal Imaging Fellow	Scientific Poster
Michael Bergquist, MD	PGY4 Diagnostic Fellow	Scientific Poster
Melissa Carroll, MD	Thoracic Imaging Fellow	Educational Exhibit
Mitchell Daun, MD	Musculoskeletal Imaging Fellow	Educational Exhibit
James Flannery, MD	Abdominal Imaging Fellow	Educational Exhibit
Catherine Harnois, MD	Musculoskeletal Imaging Fellow	Scientific Poster
Matt Larson, MD	PGY3 Diagnostic Resident	Educational Exhibit
Edward Lawrence, MD	Abdominal Imaging Fellow	Educational Exhibit
Petra Lovrec, MD	Molecular Imaging/PET Fellow	Scientific Poster
Scott Mauch, MD	PGY4 Diagnostic Resident	Educational Exhibit
Ece Meram, MD	PGY3 Diagnostic Resident	Educational Exhibit
Matt Petterson, MD	PGY5 Diagnostic Resident	Educational Exhibit
Matt Petterson, MD	PGY5 Diagnostic Resident	Scientific Poster
Jen Pitts, MD	PGY3 Diagnostic Resident	Educational Exhibit
Simarjeet Puri, MS3	Medical Student 3	Educational Exhibit
Thomas Reher, MD	Neuroradiology Fellow	Educational Exhibit
Sean Rose, PhD	Former Medical Physics Resident	Educational Exhibit
Nick Stabo, MD	PGY5 Diagnostic Resident	Educational Exhibit
Nick Stabo, MD	PGY5 Diagnostic Resident	Scientific Poster
Quinn Steiner, MS2	Medical Student 2	Educational Exhibit
Kyle Werth, MD	Neuroradiology Fellow	Educational Exhibit
Ian Wolf, MS2	Medical Student 2	Educational Exhibit

Moderators: Lindsay Stratchko, DO and Vinny Meduri, MD

Awards will be given in the following categories: *Best Resident Presentation, Best Fellow Presentation, and Best Electronic Exhibit*. The awards will be announced and presented at the various graduation celebrations in May and June.

Electronic Exhibits

[Click Here for Website Link to Electronic Exhibits](#)

7:30 AM – 8:30 AM

Scientific Session

Oral Presentations

Allison Couillard, MD

Microwave ablation as bridging to liver transplantation for patients with hepatocellular carcinoma: a single-center retrospective analysis

Edward Lawrence, MD

Water-soluble contrast challenge for suspected small bowel obstruction

Nancy Ann Little, MD

Effect of Metal Speculum During Hysterosalpingography on Patient Radiation Dose

Petra Lovrec, MD

Metastatic Disease Response and Patterns of Recurrence in Men with High-Risk Prostate Cancer after Neo-Adjuvant Chemohormonal Therapy and Radical

Albert Perez, MS4

Automated Deep Learning CT-based Liver Volume Segmentation: Defining Normal and Hepatomegaly for Clinical Practice

John Swietlik, MD

A model-based approach to histotripsy ablation target prediction using cone beam CT and fluoroscopy

Charles Viers, MD

Transvaginal US vs. CT in Non-pregnant Premenopausal Women presenting to the ED: Clinical Impact of the Second Examination when Both are Performed

Andrew Wentland, MD, PhD

Differentiation of Benign from Malignant Pathology-Proven Solid Renal Lesions Using Radiomics and Machine Learning

12:00 PM – 1:00 PM

Keynote Lecture

Introduction and Welcome

Scott Reeder, MD, PhD

Remembering Dr. Zachary Clark

Tabassum Kennedy, MD

Introduction of Lovell Scholars

Thomas Grist, MD

Curran Bice, Samuel Koebe, Alberto Perez, Anna Sorensen, Andrew Voter, Max Wrobbel

Introduction of Keynote Speaker

Jeff Kanne, MD

**Science and Practice of Imaging-Based Screening:
Radiologist Educational and Leadership Opportunities**

Linda Haramati, MD

Professor, Radiology and Medicine

Albert Einstein College of Medicine

Director, Cardiothoracic Imaging

Director, Cardiothoracic Imaging Fellowship Program

Montefiore Medical Center, Bronx, NY

Oral Presentation

Allison Couillard, MD

PGY2 Diagnostic Resident

Microwave ablation as bridging to liver transplantation for patients with hepatocellular carcinoma: a single-center retrospective analysis

Purpose: To evaluate the efficacy of microwave (MW) ablation as first-line locoregional therapy (LRT) for bridging patients with hepatocellular carcinoma (HCC) to liver transplant.

Materials and Methods: This retrospective study evaluated 88 patients who received percutaneous MW ablation of 141 tumors as first-line LRT for HCC and were listed for liver transplantation at a single institution between 2011 and 2019. Overall survival rate status-post liver transplant, wait list retention and disease progression were evaluated using Kaplan-Meier techniques.

Results: Of the 88 patients listed for transplant, 81% (71/88 patients) eventually went on to receive a liver transplant, while 19% (17/88 patients) fell off of the wait list. Of those patients, four patients fell off due to tumor growth outside of the Milan criteria. The primary local tumor progression (LTP) rate was 7% (10/138 tumors; 3 excluded due to lack of follow-up). The overall survival status-post liver transplantation at 5-years was 75.0% and the disease-specific survival after transplantation is 91.8% with a median follow-up time of 32 months. There was an overall complication rate of 5% (5/99 procedures).

Conclusion: In this single center retrospective trial, MW ablation appears to be a safe and effective locoregional therapy for bridging patients with hepatocellular carcinoma to liver transplant with good disease-specific survival after liver transplant.

Oral Presentation

Edward Lawrence, MD

Abdominal Imaging Fellow

Water-soluble contrast challenge for suspected small bowel obstruction

Presented at: Radiological Society of North America Annual Meeting, Virtual, November 28th – December 2nd 2020

Teaching points:

- With optimized technique, the water-soluble contrast (WSC) challenge is effective at triaging patients for operative versus non-operative management of small bowel obstruction (SBO)
- Standardized study structure and interpretation guidelines aid in clinical efficacy and ease of use
- Many tips and tricks exist regarding interpretation, and their understanding may assist the interpreting radiologist

Outline:

1. Brief introduction to WSC challenge
2. Indications for WSC challenge
3. Protocol & technique
4. Case-based review
 1. Study results
 2. Challenges and special cohorts
 3. CT-based WSC challenge

Oral Presentations

Nancy Ann Little, MD

PGY2 Diagnostic Resident

Effect of Metal Speculum During Hysterosalpingography on Patient Radiation Dose

Presented at: American Roentgen Ray Society Annual Meeting, Virtual, April 19th – April 22nd, 2021

Purpose: Hysterosalpingography (HSG) technique varies in our department regarding the speculum; some leave the speculum in place while others remove the speculum during contrast injection and image capture. This raised concern whether the presence of this metallic object would affect the machine's automatic exposure control (AEC) and increase patient radiation dose. An argument to leave the speculum in place is to minimize the risk of displacing the catheter during speculum removal and an argument to remove the speculum is to minimize radiation dose. The purpose of this study is to determine whether radiation dose of HSG is increased when a speculum is present.

Materials/Methods: In this retrospective cohort study, we collected demographic, technique, and radiation dose data for all HSGs performed by abdominal radiologists between 8/1/2018 and 8/26/2020. HSGs were performed on a Siemens Luminos Agile Max fluoroscopy machine. Dose data was collected for the first AP single shot of each HSG. Of the 77 unique patient encounters, 12 were excluded due to missing data (n=8), variation in technique (n=3), or high body mass index (BMI) outlier (n=1). The remaining 65 encounters represented HSGs performed by one of 8 attending radiologists in which at least one AP single-shot image was obtained (33 with metal speculum, 32 without). Linear regression analysis was applied to compare patient radiation dose, as measured by reference air kerma, between images with and without a speculum in frame. Subsequent F-test assessed whether presence of the speculum impacted reference air kerma. We additionally investigated the response of our fluoroscopy system's AEC to a metal speculum using an acrylic and aluminum phantom simulating a 20cm patient thickness.

Results: After adjusting for source to detector distance (SID), magnification mode, and BMI, the average reference air kerma was 0.89mGy [0.81, 0.98] for images without and 0.84mGy [0.77, 0.92] for images with a speculum (95% confidence intervals in brackets); there is no significant difference in reference air kerma (p=0.44). The fluoroscopy system's AEC uses two laterally located regions of interest (ROIs) in our HSG protocol. In our phantom study, we obtained a reference air kerma of 0.38mGy with no speculum in the X-ray beam. With the speculum placed at locations simulating clinical practice, reference air kermas ranged from 0.38mGy-0.41mGy (0-8% increase). Attempting to fully block one of the AEC ROIs with a speculum increased the reference air kerma from 0.38mGy to 0.57mGy (50% increase); however, this position would not be used clinically.

Conclusion: In our study population, there was no increase in entrance radiation dose with metal speculum left in place, and phantom testing revealed at most an 8% increase for clinically feasible speculum locations. It is critical to emphasize this result is due to specific protocols that do not increase machine output with centrally-located radiopacity and physicist colleagues should be consulted to ensure appropriate local examination protocols.

Authors: Nancy Ann Little, Sean Rose, John Vetter, Jessica Robbins, Meghan Lubner

Oral Presentation

Petra Lovrec, MD

Molecular Imaging/PET Fellow

Metastatic Disease Response and Patterns of Recurrence in Men with High-Risk Prostate Cancer after Neo-Adjuvant Chemohormonal Therapy and Radical

Presented at: Society of Nuclear Medicine and Molecular Imaging Annual Meeting, Virtual, June 11th – June 15th, 2021

Purpose: Although it is known that the overall risk of prostate cancer (PCa) recurrence after radical prostatectomy depends on the risk group and pathologic features, there is limited information on metastatic disease patterns of response and recurrence after neoadjuvant chemohormonal therapy followed by prostatectomy in patients with high-risk PCa. It was our aim to evaluate this utilizing the prostate-specific membrane antigen (PSMA)-based 18F-DCFPyL (PyL) PET imaging.

Methods: Patients with newly diagnosed high-risk PCa underwent a baseline PyL whole body PET/CT (PET1) followed by neoadjuvant docetaxel and androgen deprivation therapy. Repeat set of imaging was obtained prior to prostatectomy (PET2), and 1 yr after prostatectomy or earlier if PSA progression criteria were met (PET3). Scans were evaluated by a two independent-reader central review with third-reader adjudication. Sites of suspected PET-positive metastatic disease were evaluated by 5-point scale, anatomic region (pelvic nodal [LN], extrapelvic LN and bone), and maximum standardized uptake value (SUVmax). Interval SUVmax (iSUV) change between each time point was calculated as absolute and percent change for the highest intra-patient SUVmax metastasis (hottest lesion) and up to 5 hottest lesions per region (tumor burden).

PET findings were correlated to progression type based on PSA progression (no progression [NP], early progression ≤ 1 yr post-prostatectomy [EP], or late progression >1 yr post-prostatectomy [LP]), time to progression (TTP) and interval PSA change (iPSA).

Results: A total of 27 patients were enrolled. At the time of evaluation, 10 patients were disease free, 16 patients demonstrated early or late recurrence, and 1 patient was lost to follow up. Median follow-up time was 659 days (range 364-928).

12 of 16 patients with disease progression presented with metastatic disease on initial exam, 10 of whom exhibited EP. Patients with bone and extrapelvic LN metastases were associated with poor outcome and EP (4 of 5 and 7 of 7, respectively). Presence of >3 intrapelvic LN metastases was also associated with poor outcome and EP (8 of 8). No new sites of metastatic disease were seen on PET2 or PET3, and all patients progressed at the sites of initially identified metastases on PET1. Absence of metastatic disease at PET1 was correlated with durable PSA response to therapy (8 of 10).

Significant correlation was found between tumor burden iSUV change and iPSA change ($r = -0.58$), but no significant correlation was found between tumor burden iSUV change and TTP ($r = -0.25$) or outcome. Median absolute iSUV change for NP was -0.20 (range -0.10 to -0.30), EP -3.60 (range 2.45 to -25.20) and LP -2.60 (range -0.70 to -4.50). Median percent iSUV change for NP was -7.70 % (range -3.85 to -11.54), EP -59.16 % (range 13.69 to -84.37) and LP -54.53 % (range -24.14 to 84.91).

The initial hottest lesion SUVmax was significantly different for EP, LP, and NP, and inversely associated with time to progression ($r = -0.48$).

Conclusion: Initial staging DCFPyL PET detection of >3 intrapelvic LN, any extrapelvic LN or bone metastases in patients with high-risk PCa was associated with early progression. All patients with progressive disease progressed at the sites of metastatic disease identified at baseline, and no new sites of PET positive metastatic disease were found at time of progression. SUVmax of the hottest metastasis on initial exam was prognostic of time to progression and overall change in metastatic disease PET uptake on chemohormonal therapy was correlated to the iPSA change. However, no significant correlation was found between interval SUVmax change on neoadjuvant chemohormonal therapy and progression type or TTP. DCFPyL PET imaging can provide important prognostic information to patients with high-risk primary prostate cancer undergoing neoadjuvant chemohormonal therapy.

Authors: Petra Lovrec, Patrick Belson, Shane Wells, Christos Kyriakopoulos, Wei Huang, David Beebe, Joshua Lang, David Jarrard, Steve Y. Cho

Oral Presentation

Albert Perez, MS4

Medical Student 4

Automated Deep Learning CT-based Liver Volume Segmentation: Defining Normal and Hepatomegaly for Clinical Practice

Presented at: European Society of Gastrointestinal and Abdominal Radiology Annual Meeting, Virtual, June 15th - 18th, 2021

Purpose: Imaging assessment for hepatomegaly is not well defined and currently utilizes suboptimal unidimensional measures. Liver volume provides a more direct measure for organ enlargement. We applied a validated deep learning artificial intelligence (AI) tool that automatically segments the liver for organ volume, and sought to establish thresholds for hepatomegaly.

Methods: Hepatic volumes were successfully derived with the deep learning tool from 3065 asymptomatic outpatient adults (mean age 54.3 years; 1426M/1639F) who underwent MDCT for either colorectal screening (n=1960, unenhanced) or renal donor evaluation (n=1104, contrast-enhanced). Linear regression analysis was utilized to assess major patient-specific determinant(s) of liver volume amongst age/sex/height/weight/BSA. Threshold for hepatomegaly was set at two standard deviations above the mean for the final modeled equation. Accuracy of craniocaudal and maximal 3D linear measures was assessed. Manual liver volume was compared with automated results in a subset of 189 patients. Unenhanced liver volumes were standardized to a post-contrast equivalent, reflecting a small but constant 3.6% correction.

Results: Mean standardized automated liver volume was 1533 ± 375 ml and demonstrated a normal distribution. Patient weight was the major determinant of liver volume, and demonstrated a linear relationship. From this, a linear weight-based upper limit of normal results in: hepatomegaly threshold volume [ml] = $14.0 \times (\text{Wt [kg]}) + 979$. Linear measures demonstrated only moderate performance for identifying volume-defined hepatomegaly. For example, a craniocaudal threshold of 19 cm was 71% sensitive and 86% specific for hepatomegaly, and a maximal 3D linear threshold of 24 cm was 78% sensitive and 66% specific. For the subset (n=189) with direct manual versus automated comparison, mean difference in hepatic volume was 2.8% (41 ml).

Conclusion: We derived a simple, weight-based threshold for hepatomegaly using an automated liver volume tool. If further validated in larger healthy and diseased cohorts, this approach could provide a more objective measure of liver size.

Authors: Alberto A. Perez, Victoria Noe-Kim, Meghan G. Lubner, Peter M. Graffy, John W. Garrett, Daniel C. Elton, Ronald M. Summers, Perry J. Pickhardt

Oral Presentation

John Swietlik, MD

PGY6 IR-Integrated Resident

A model-based approach to histotripsy ablation target prediction using cone beam CT and fluoroscopy

Presented at: Cardiovascular and Interventional Radiological Society of Europe Annual Meeting, Virtual, September 12th – 15th, 2020

Purpose: Histotripsy is an emerging ablation technology, creating mechanical tissue destruction at the cellular level, performed under ultrasound-guidance. However, tumor echogenicity, location, or body habitus can limit visualization and targeting. A recently developed technique allows tracking the 3-dimensional position and orientation of objects using biplane fluoroscopic images. The purpose of this study was to evaluate the feasibility of using fluoroscopy image sequences to predict histotripsy ablation location within ex-vivo phantom and in-vivo porcine models.

Materials and Methods: 5 histotripsy ablations were created for target prediction, 2 in ex-vivo phantom model and 3 in in-vivo porcine model (liver, kidney, and muscle). In both models the histotripsy therapy transducer was positioned to create a targeted ablation. Prior to initiation of treatment a 3D cone-beam CT and 2D fluoroscopic images were obtained of the transducer targeted at the ablation center and edges. Target position was determined based on a 3D to 2D pose estimation of the transducer using 3D point cloud model.

Results: Predictive target center accuracy error was 0.64 ± 0.23 mm in the ex-vivo model and 3.59 ± 1.17 mm in the in-vivo model. In-vivo mean target precision error (error of estimated center compared to center of estimated corner points) was 0.75 ± 0.46 mm. Estimated ablation target center depth in ex-vivo treatments was 14.02 cm (expected depth 14.0 cm).

Conclusion: Fluoroscopic imaging was able to accurately predict histotripsy ablation locations in both ex-vivo and in-vivo models. With further development, x-ray-based targeting during histotripsy may be possible and facilitate treatment of tumors not visible on ultrasound.

Authors: John Swietlik MD, Paul Laeseke MD, PhD, Sarvesh Periyasamy, Emily Knott, Annie Zevlor, Zhen Xu PhD, Fred Lee Jr MD, Timothy Ziemelewicz MD, Michael Speidel PhD, Martin Wagner PhD

Oral Presentations

Charles Viers, MD

PGY3 Diagnostic Resident

Transvaginal US vs. CT in Non-pregnant Premenopausal Women presenting to the ED: Clinical Impact of the Second Examination when Both are Performed

Background: When non-pregnant premenopausal women present to the ED with acute pelvic/lower abdominal symptoms, and both transvaginal US (TVUS) and CT obtained (in either order), the additional clinical yield of the second examination is not well established.

Purpose: To determine the clinical impact of the second examination when both CT and TVUS are obtained in the same ED visit for acute pelvic/lower abdominal symptoms in non-pregnant premenopausal women.

Methods: Search performed over a 12-month interval (March 2019-February 2020) yielded 200 consecutive non-pregnant premenopausal women (mean age, 31.8 years; range, 18-49 years) who underwent both ED-based TVUS and abdominopelvic CT evaluation for acute symptoms; 107 women had TVUS first, followed by CT; 93 women had CT first, followed by TVUS. All relevant clinical, radiologic, and pathologic findings were reviewed to establish a final diagnosis. Any additional clinical impact provided by the second imaging test was assessed and categorized by two experienced abdominal radiologists.

Results: Initial TVUS was interpreted as normal (n=63) or mentioned only unrelated incidental findings (n=11) in 69% (74/107); subsequent CT established a non-gynecologic GI or GU etiology in 25 (34%) of these. For the 37% (34/93) of CT exams interpreted as normal, TVUS added no new relevant information. In 32 additional cases (34%), TVUS further excluded ovarian torsion or other adnexal pathology when initial CT was considered indeterminate or equivocal. Overall, CT following TVUS provided a key new or alternative diagnosis not seen at US in 26% (28/107), whereas TVUS after CT provided a relevant new/alternative diagnosis in only 1 (1%) of 107 cases (p<0.001). In nine cases (8%), CT confirmed a positive US diagnosis but also detected relevant additional diagnostic information. In four cases (4%), TVUS findings were discordant with initial CT, and misleading to the final diagnosis.

Conclusion: CT following negative TVUS frequently identified a non-gynecologic cause of acute pelvic or lower abdominal symptoms in non-pregnant premenopausal women, whereas the main benefit of TVUS after CT was more confident exclusion of ovarian torsion. TVUS rarely identified relevant positive information not seen on CT.

Authors: Charles D. Viers, Meghan G. Lubner, Perry J. Pickhardt

Oral Presentations

Andrew Wentland, MD, PhD

Abdominal Imaging Fellow

Differentiation of Benign from Malignant Pathology-Proven Solid Renal Lesions Using Radiomics and Machine Learning

Presented at: Society for Advanced Body Imaging Annual Meeting, Virtual, October 10th – 13th, 2020

Purpose: To extract radiomics features from pre-operative contrast-enhanced CT images and to use these features to develop a machine learning model for distinguishing benign from malignant solid renal lesions.

Materials/Methods: Pre-operative contrast-enhanced CT studies of 148 solid renal lesions were curated. The associated histologic diagnosis was determined for each lesion from the pathology records. Images were imported into a radiomics research prototype (syngoVia Frontier, Siemens Healthineers, Forchheim, Germany). Volumetric segmentation of each lesion was performed semi-automatically by the software; small adjustments were performed manually as needed for the segmentation. Radiomics features were computed from the prototype software using the built-in PyRadiomics framework. Radiomics features were exported from the software and utilized in a custom random forest classifier machine learning model. A 70/30 train/test split was employed. Receiver operating characteristic (ROC) and precision-recall curves were computed. The model accuracy and F1 score were determined.

Results: Of the 148 solid renal lesions, 51 were benign (23 lipid-poor AMLs and 28 oncocytomas) and 97 were renal cell carcinoma (31 chromophobe type, 23 clear cell type, and 43 papillary type). From the software 854 radiomics features were derived. The machine learning model achieved an 80% accuracy on the test set. The precision-recall curve demonstrated a mean precision of 0.84 and an area of 0.78 was found under the ROC curve. The F1 score was 0.79.

Conclusion: Radiomics features can be used to build a machine learning model that can distinguish benign from malignant solid renal lesions with high accuracy.

Authors: Wentland AL, Yamashita R, Kamaya A.

Electronic Presentations

Scientific Poster Electronic

Abdul Abdelazim, MD

Abdominal Imaging Fellow

Percutaneous microwave ablation of stage T1b RCC: A single center, retrospective study

Presented at: Society of Abdominal Radiology Annual Meeting, Virtual, March 21st – 25th, 2021

Objective: To evaluate oncologic efficacy of percutaneous microwave ablation (MWA) for treatment of clinically localized T1b (cT1b) renal cell carcinoma (RCC).

Methods: This HIPAA-compliant, single-center retrospective study was performed under a waiver of informed consent. Eighty-nine consecutive patients (60M/29F) with 89 cT1b RCC (median tumor diameter 4.6cm, IQR: 4.3-5.3cm) were treated with percutaneous MWA between May 2012 and August 2020. Patient and procedural data collected included BMI, Charlson comorbidity index (CCI), RENAL nephrostomy score (NS), tumor grade and histology, use of hydrodisplacement, number of antennas, MWA generator output power/time, and procedure time. Patients were stratified into two groups based upon if antennas were repositioned for additional ablation. Primary efficacy, complications, local tumor progression (LTP) and metastatic disease were compared using the Wilcoxon rank sum test. The Kaplan Meier method was used for survival analysis.

Results: Patients were elderly (median age 69, IQR 65-76) and obese (BMI 34, IQR: 28-41) with numerous comorbidities (CCI 6, IQR: 5-7). Low-grade (68/89, 88%) and clear cell RCC (72/89, 81%) were most common at histology. Hydrodisplacement (median 0.5L, IQR 0.3-0.7) was used in 43/89 (48%) of procedures. 3 (IQR 3-3) MWA antennas were powered at 65W (IQR 65-65) for 7 min (IQR 5-10) for treatment. Median duration of follow-up was 19.8 months (IQR 9.4-33.9). Tumors were larger (4.5 vs 5.2cm, $p=0.001$), procedure time longer (1.7 vs 2.2hr, $p=0.02$) and there was a trend towards higher LTP (4% vs 17%, $p=0.07$) for the antenna reposition/additional ablation cohort (42/89, 47%). NS (8 vs 8), complication rate (15% vs 26%), primary efficacy (94% vs 91%) and metastasis (13% vs 7%) were similar ($p=0.2-0.7$).

Conclusion: Percutaneous MWA is an effective and safe treatment option for cT1b RCC in an elderly and comorbid cohort. Long-term follow-up is needed to establish durable oncologic efficacy and survival relative to other management approaches.

Scientific Poster Electronic

Michael Bergquist, MD

PGY4 Diagnostic Resident

From Clivus to Coccyx and anywhere in between, a case presentation of a mid-cervical chordoma

Presented at: American Society of Neuroradiology (ASNR) Las Vegas 4/2020 - Virtual Meeting

Purpose: Review the imaging findings of a chordoma and correlate these with the embryologic origin of the lesion.

Case Report: A 26 year old female presenting with one year of bilateral upper extremity paresthesia's worse with neck hyperflexion (Lhermitte's phenomenon), upper extremity hyperreflexia, and constant dull neck pain found to have an extradural mass at C3-5 originating from the lateral C4 vertebral body. Following imaging work-up, the patient underwent preoperative embolization of the left vertebral artery followed by resection, anterior cervical spinal fusion, and adjuvant radiation.

Imaging Findings: On MR, this extra-dural mass was avidly T2 hyperintense and T1 hypointense with lobular contours arising from the lateral C4 vertebral body filling and expanding the left foramen transversarium. This mass undermined and uplifted the posterior longitudinal ligament and caused severe canal stenosis displacing the thecal sac posteriorly. Post contrast images demonstrated ill-defined, minimal linear enhancement of the mass and with patent left vertebral artery. A CT myelogram performed demonstrated an extra-dural expansile lesion without any osseous matrix or intra-tumoral calcification along the posterolateral surface of the C3-5 vertebral bodies. There was significant expansion of the left foramen transversarium and encase of the left vertebral artery without cortical disruption or osseous erosion.

Summary: Chordoma's are slow growing tumors which arise from notochordal remnants, which reside in the midline of the neuroaxis from the basio-occiput to the sacrum. These tumors characteristically contain physaliphorous ("bubble bearing") cells with vacuolated, lobular cytoplasm giving these lesion an expansile, avidly hyperintense T2 appearance with lobular contours. Both MR and CT are often needed to differentiate these lesions from chondrosarcomas which can have a similar MR appearance, but CT can differentiate the chondroid matrix seen in chondrosarcomas versus lytic destruction and resultant erosive calcification seen with chordomas. Historically thought be most common in the sacrum or clivus, chordomas are now known to be relatively equally distributed between the occiput, spine, and sacrum. This case illustrates the classic imaging appearance of a chordoma regardless of where it originates along the cranio-caudal axis in the spine.

Authors: Bergquist M, Yu JP, Kennedy T

Scientific Poster Electronic

Michael Bergquist, MD

PGY4 Diagnostic Resident

Longer term clinical outcomes of unilocular or multilocular cystic presacral lesions

Presented at: Society of Abdominal Radiology Annual Meeting, Maui, Hawaii, March 1st – March 6th 2020

Purpose: To assess outcomes of cystic presacral masses with a specific imaging appearance to help guide future management options.

Material and Methods: Radiologic and surgical databases at a single academic medical center were queried for cystic presacral masses from 2005-2018. Excluding duplicates, 52 cases were identified. From this group, the imaging was reviewed to meet the following criteria: (1) unilocular or multi-locular morphology; (2) thin smooth walls or septations without nodularity; (3) contiguous with the coccyx without bone erosion. 28 lesions met all 3 criteria, constituting the study cohort. Final pathologic diagnoses were obtained for resected lesions and clinical outcomes assessed for lesions under imaging surveillance.

Results: The mean age of the cohort was 48.5 yrs \pm 15.7std. 85.7% (24/28) were female. Mean size of presacral lesions 4.4 cm \pm 2.2std with resected lesions larger than unresected ones (ave 5.6cm \pm 2.8std vs 3.8cm \pm 1.5std, respectively; $p < 0.04$). 10 were multilocular; 18 unilocular. All lesions (n=28) were contiguous with the coccyx and did not extend cephalad to S3. 10/28 lesions were resected; all benign in nature [retro-rectal cystic hamartomas (6), epidermoids (2), mature cystic teratoma (1), duplication cyst (1)]. 18 patients did not undergo resection with an average follow up 4.7 yrs \pm 3.0std (range 0.5-13 yrs). 15 stable in size; 2 decreased. One lesion increased 1.5 cm over 6 yrs but not resected. No infection or malignancy seen for any of the lesions followed.

Conclusions: Pre-coccygeal, uni or multiloculated cystic masses with thin septa indicate benign features or clinical course, potentially allowing for more conservative management.

Authors: Bergquist M, Kim DH

Education Exhibit Electronic

Melissa Carroll, MD

Thoracic Imaging Fellow

Intrathoracic Torsions: Twist and Shout

Presented at: Society of Thoracic Radiology Annual Meeting, Virtual, March 6th – 10th, 2021

Background Information: Intrathoracic torsion refers to twisting of a structure along the long axis with varying degrees of rotation and can involve various organs in the chest including the lungs, heart, or gastrointestinal tract. Torsion can occur because of a structural predisposition, the result of trauma, or as a rare postoperative complication and can be either intermittent or persistent. Torsions often occur around a vascular pedicle, thus compromising blood flow and necessitating emergent surgical intervention to avoid infarction of an organ. The radiologist plays an important role in identifying and accurately describing torsion to facilitate appropriate management whether it be conservative observation or emergent surgical intervention.

Educational Goals/Teaching Points:

1. Accurate identification of intrathoracic torsion is crucial to proper patient management particularly when emergent surgical intervention is needed.
2. Intrathoracic torsions can occur in the setting of trauma, result from predisposition, or as a postoperative complication.
3. Comprehensive imaging review of intrathoracic torsions requiring immediate surgical intervention such as lobar and whole lung torsion, cardiac torsion, and intrathoracic gastric volvulus.
4. Identify non-life-threatening torsions such as mediastinal fat pad torsion and round atelectasis.
5. Focus on use of a “follow the lumen” method and vascular pedicle assessment as key to accurate diagnosis of intrathoracic torsions.

Conclusions: Familiarity with imaging presentation of intrathoracic torsions is crucial to timely diagnosis and patient management, as undiagnosed or misinterpretation of torsion can have a high mortality rate. Evaluating the vascular pedicle and tracking the lumen of the torsed organ can be valuable methods for accurate interpretation.

Authors: Melissa Carroll, M.D., Christopher Meyer, M.D., Maria Daniela Martin Rother, M.D., Joanna Kusmirek, M.D., Jeffrey Kanne, M.D.

Educational Exhibit Electronic

Mitchell Daun, MD

Musculoskeletal Imaging Fellow

Imaging Diagnosis and Radiology Directed Management of Pseudomeningoceles

Presented at: Association of University Radiologists Annual Meeting, Virtual, May 3rd – 6th, 2021

Purpose:

- Review the clinical features of pseudomeningoceles including principle etiologies, methods of classification, clinical presentation, and methods for treatment.
- Highlight the key imaging features of pseudomeningoceles across multiple radiologic modalities.
- Utilize a multimodality case-based approach to reinforce key concepts in the diagnosis and management of pseudomeningoceles.

Materials/Methods:

- We performed a review of the recent radiologic, orthopedic, and neurosurgical literature regarding CSF leaks and pseudomeningoceles.
- We performed a review of cases at our institution, with a focus on including a broad variety of presentations and imaging findings.

Results:

- An educational project targeting radiology trainees, but applicable to radiologists in academic centers as well as the community.

Authors: Mitchell Daun, MD; Anna Sorensen; Lindsay Stratchko, DO; Joseph Tang; Allison M. Grayev, MD; Andrew B. Ross, MD

Educational Exhibit Electronic

James Flannery, MD

Abdominal Imaging Fellow

Ultrasound-guided biopsies: Techniques to improve target visualization

Purpose: Highlight procedural and imaging techniques to improve biopsy target visualization and accessibility, specifically: Contrast enhanced ultrasound and compression with ultrasound transducer

Materials/Methods: Cases from UW

Author(s): James Flannery

Scientific Poster Electronic

Catherine Harnois, MD

Musculoskeletal Imaging Fellow

Diagnostic Accuracy of Rapid MR with Compressed Sensing for Diagnosis of Occult Hip Fracture

Purpose: To determine the diagnostic accuracy and usefulness of the Rapid MR Protocol with Compressed Sensing in patients presenting to the Emergency Department with a suspected radiographically occult hip fracture.

Materials/Methods: A local PACS search retrospectively identified patients aged 65 and over, who presented to the Emergency Department between April 2018 and October 2020 with a working diagnosis of radiographically occult hip fracture, and who underwent imaging with the rapid MR protocol. Selected clinical and imaging data per patient included pelvis and hip radiographs result, CT bony pelvis result, treatment plan and disposition. Any subsequent healthcare encounter within 30 days of discharge was analyzed, searching for a history of completion hip fracture, adverse event, or healing hip fracture on imaging. Standard statistical measures were extrapolated from the data set.

Results: 129 emergency encounters met our inclusion criteria, of which a majority of patients were female (91; 70%). The mean age of selected patients was 80-year-old (65-99). Radiographically occult, proximal femur fractures were diagnosed on rapid MR in 16 patients (12%) and further divided into femoral neck fractures (8; 6%), intertrochanteric fractures (7; 5%) and sub trochanteric fracture (1; 1%). The most common diagnoses made on rapid MR protocol were soft tissue injuries (47/129; 36%) and pelvic fractures (28/129; 22%). 12 patients (9%) required surgical management and a total of 78 patients were admitted (61%) to an inpatient ward. 37 patients (29%) had no acute injury on rapid MR, most of which were subsequently discharged home. 101 patients (78%) had a subsequent healthcare encounter within 30 days of discharge, none of which revealed a missed fracture or missed injury (sensitivity 100%).

Conclusion: The rapid MR protocol is a sensitive, specific, and time-efficient diagnostic tool that can identify a plethora of radiographically occult, osseous, and soft tissue pathologies. The use of such protocol in the emergency setting provides guidance to clinical teams in expediting diagnosis and promoting prompt, tailored management.

Author(s): Catherine Harnois, Anna Marie Sorensen, Kenneth Lee, Andrew B. Ross

Educational Exhibit – Electronic

Joe Lang, MD

Neuroradiology Fellow

Horner Syndrome and The Oculosympathetic Pathway: A Case Based Approach

Educational Objectives:

1. To identify the components of Horner syndrome and the Oculosympathetic pathway
2. Integrate clinical history with anatomic knowledge of the Oculosympathetic pathway to better localize pathology
3. Develop a focused differential diagnosis based on clinical symptoms and imaging findings

Conclusion:

1. Horner syndrome is the clinical syndrome most commonly featuring ptosis, miosis and anhidrosis and is the result of disruption of ipsilateral sympathetic nerve fibers.
2. Understanding the anatomy of the Oculosympathetic pathway, with central, preganglionic and postganglionic components, is critical for accurate interpretation of imaging in the setting of Horner syndrome.
3. The identification of clinical features unique to the separate components of the sympathetic pathway should guide imaging selection and search pattern.

Educational Exhibit – Electronic

Matthew Larson, MD

PGY3 Diagnostic Resident

Evaluation of Pancreas Transplants: A Case Based Review

Presented at: Radiological Society of North America Annual Meeting, Virtual, November 28th – December 2nd 2020

Purpose: Demonstrate the anatomy and multimodality imaging evaluation of pancreas transplants, including normal and pathological states.

Materials/Methods: Background was generated by literature review. Diagrams of pancreas anatomy were generated. Clinical cases from the co-authors were utilized.

Results/Conclusion: This exhibit provides a comprehensive review of indications for pancreas transplant, pancreas transplant anatomy, multimodality imaging evaluation of the transplant pancreas, including normal appearance and the appearance of common pancreas transplant complications.

Authors: Matthew Larson, MD, PhD, Ghaneh Fananapazir, MD, Anjali Bagley, MD, Tara Morgan, MD, Margarita Revzin, MD, Meghan Lubner, MD, and Lori Mankowski Gettle, MD, MBA

Educational Exhibit Electronic

Edward Lawrence, MD

Abdominal Imaging Fellow

Pushing the limits: ultrasound-guided biopsy of challenging and deep abdominopelvic targets

Presented at: SAR Annual Meeting and ARRS Annual Meeting

Background: Percutaneous ultrasound-guided biopsies have become standard of practice for tissue diagnosis in the abdomen and pelvis for many sites including liver, kidney, and peripheral nodal stations. Additional targets may appear difficult or impossible to safely biopsy by ultrasound due to interposed bowel loops/vasculature, deep positioning, or lack of operator experience; however, by optimizing technique, it is often possible to safely and efficiently use ultrasound guidance for sampling targets that normally would be considered for CT-guided or surgical/endoscopic biopsy.

Learning Objectives:

1. Review key factors that affect the success of percutaneous ultrasound-guided biopsies
2. Learn 'tip and tricks' about how to optimize your ultrasound-guided biopsies for challenging or deep abdominopelvic targets
3. Review case examples of successful ultrasound-guided biopsies of challenging or atypical targets commonly reserved for CT or surgical biopsy.

Key Content:

1. Patient positioning can allow for improved sonographic visibility of the biopsy target and allow for safe access to deep targets, and is often determined by an iterative and collaborative process with the assisting sonographer.
2. CT planning at the time of biopsy can help to determine the optimal patient and probe positioning for smaller or mobile targets.
3. Applying firm pressure with the sonographic probe allows for targets that are deep on CT to be significantly closer to the skin and thus readily accessible to ultrasound-guided biopsy.
4. Microbubble ultrasound contrast can improve visibility of small targets both for pre-biopsy planning or for real-time administration during the biopsy itself
5. Examples of 'deep' targets that often can be approached using ultrasound include periaortic, iliac and mesenteric lymph nodes, retroperitoneal and mesenteric masses, and pelvic masses.

Educational Exhibit Electronic

Edward Lawrence, MD

Abdominal Imaging Fellow

Unwrapping the stomach on CT: An interactive case based review of inflammatory disorders and their neoplastic mimics

Presented at: Society of Abdominal Radiology Annual Meeting, March 20-25 and American Roentgen Ray Society Annual Meeting, April 18-22

Background: The stomach and duodenum are a common source of upper abdominal pain. Issues with variable luminal distention and overlapping findings can make confident CT evaluation difficult. However, there are key findings for neoplastic and non-neoplastic conditions that the radiologist can identify which offer important value-added and may significantly impact patient management and outcomes.

Objectives:

1. Review relevant anatomy and how localization, especially of air or oral contrast, may point to the underlying etiology or source
2. Interact with a collection of cases, both neoplastic and inflammatory, with emphasis on key findings and interpretation tips
3. Develop differentiating criteria for distinguishing benign from malignant gastric or duodenal thickening

Take home points:

1. Localizing extraluminal fluid/air can help find the location of perforation
2. Lower attenuation (edema) or mural stratification favors benign
3. Higher attenuation/enhancement is suspicious for infiltrative tumor
4. The most challenging neoplastic mimics are lymphoma and adenocarcinoma (including linitis plastica)

Educational Exhibit Electronic

Edward Lawrence, MD

Abdominal Imaging Fellow

Water-soluble ('Gastrograffin') contrast challenge for suspected small bowel obstruction

Presented at: RSNA annual meeting 2020

Teaching points:

- With optimized technique, the water-soluble contrast (WSC) challenge is effective at triaging patients for operative versus non-operative management of small bowel obstruction (SBO)
- Standardized study structure and interpretation guidelines aid in clinical efficacy and ease of use
- Many tips and tricks exist regarding interpretation, and their understanding may assist the interpreting radiologist

Outline:

1. Brief introduction to WSC challenge
 2. Indications for WSC challenge
 3. Protocol & technique
 4. Case-based review
- Study results
 - Challenges and special cohorts
 - CT-based WSC challenge

Scientific Poster Electronic

Petra Lovrec, MD

Molecular Imaging/PET Fellow

PSMA-based 18F-DCFPyL PET/MRI for Prediction of Progression and Assessment of Response to Neo-Adjuvant Chemohormonal Therapy in Men with High-Risk Primary Prostate Cancer

Presented at: Society of Nuclear Medicine and Molecular Imaging Annual Meeting, Virtual, June 11th – June 15th, 2021

Purpose: Neoadjuvant chemohormonal therapy followed by cytoreductive radical prostatectomy is a new therapeutic approach in patients with newly diagnosed high-risk primary prostate cancer (PCa) with oligometastatic disease. We aimed to evaluate the utility of prostate-specific membrane antigen (PSMA)-based 18F-DCFPyL (PyL) PET imaging for assessment of primary PCa response to neoadjuvant chemohormonal therapy and its value in predicting disease progression in men with high risk PCa.

Methods: Patients with newly diagnosed high-risk PCa underwent baseline PyL pelvic PET/MRI (PET1) followed by 3 cycles of neoadjuvant docetaxel and androgen deprivation therapy. PyL pelvic PET/MRI was repeated after neoadjuvant therapy and prior to radical prostatectomy (PET2). Patients had follow-up PyL PET/MR imaging at 1 year after prostatectomy, or earlier if they met criteria for prostate specific antigen (PSA) progression, and subsequent clinical follow-up.

Primary PCa lesions were evaluated at both imaging time-points (PET1 and PET2). Prostate contours were delineated anatomically on oblique axial T2 MRI sequences and transferred to registered PET images using MIM Encore® v6.8.7 software. For PET tumor quantification, prostate subcontours were created using a standardized uptake value (SUV) threshold of 3.7, which was the 95% confidence interval of prostate background SUVmax. Primary PCa PET parameters including SUVmax, metabolic tumor volume (MTV) and total lesion PSMA (TLP) were measured for both PET1 and PET2 time points. Interval change of quantitative PET tumoral parameters from PET1 to PET2 was calculated as absolute and percent change (iSUV, iMTV, iTLP). Blood PSA level at baseline and after neoadjuvant chemohormonal therapy was also obtained. All data was correlated with time to PSA progression.

Results: 27 patients were enrolled. At the time of evaluation, 10 patients were disease free and 17 patients demonstrated early or late PSA progression (≤ 1 yr or >1 yr after prostatectomy, respectively). Median time to progression was 209 days (range 63-587). Median clinical follow-up was 659 days (range 364-928). Baseline PSA ranged from 4.5 to 326.7 ng/ml (median 21.0, mean 39.6). Interval PSA change ranged from -317.3 to -4.4 ng/ml (median -20.5, mean -38.8).

Median baseline primary PCa PET1 SUVmax measured 28 (interquartile range [IQR] 21-37, range 7.4-76), MTV 18 (IQR 10-30, range 3.7-156) and TLP 122 (IQR 65.8-330, range 17.4-4992). Median post-chemohormonal primary PCa PET2 SUVmax measured 12 (IQR 8.2-22, range 4.9-64), MTV 6.5 (IQR 3.5-12, range 0.7-43) and TLP 28.3 (IQR 16-95.8, range 2.9-516). Median percent iSUV change was -51.8 (IQR -

65.7 to -16, range -82.9 to 75.7), percent iMTV change was -69.1 (IQR -78.4 to -38.9, range -94.8 to 122.2) and percent iTLP change was -79.5 (IQR -86.7 to -46.7, range -96.9 to 55.5).

Cox regression analysis found baseline MTV ($p=0.0028$), baseline TLP ($p=0.0074$) and baseline PSA levels ($p=0.0004$) to be significant predictors of time to progression. Multivariable analysis with model selection found baseline PSA to be the most significant predictor of outcome. Interval change in PET imaging parameters was not found to be significantly associated with time to progression.

Conclusion: Preliminary results demonstrate baseline primary PCa DCFPyL PSMA PET parameters of tumor burden and blood PSA level to reliably predict disease progression in high-risk PCa patients undergoing neoadjuvant chemohormonal therapy. Further analysis of PSMA PET/MRI derived temporal and textural imaging characteristics on treatment response assessment and patient prognosis are ongoing.

Authors: Petra Lovrec, Tyler Bradshaw, Christos Kyriakopoulos, Wei Huang, David J. Beebe, David Jarrard, Joshua Lang, Shane Wells, Steve Y. Cho

Educational Exhibit Electronic

Scott Mauch, MD

PGY4 Diagnostic Resident

Post Ablation Imaging Findings: From Normal to What is That?

Presented at: Society of Abdominal Radiology Annual Meeting, Maui, Hawaii, March 1st – March 6th 2020

Purpose:

1. To improve understanding of normal imaging findings post-ablation
2. To review the expected appearance of local tumor progression and common complications of ablation
3. To make the learner aware of rare presentations of local tumor progression and complications of ablation

Material/Methods: Thermal ablation is a first line treatment modality in selected patients with liver and renal malignancies and is steadily increasing in utilization for other indications. Post ablation imaging is essential to evaluate treatment response, monitor for recurrence, and guide future treatments. As such, there is a growing body of reported imaging findings following thermal ablation. Understanding the expected evolution of these findings post ablation, as well as different presentations of recurrence, is therefore crucial to the radiologist's interpretation of such imaging.

Results:

This exhibit will review:

1. Normal post-ablation imaging findings on CT and MRI to minimize mischaracterization of these findings.
2. Typical imaging findings of local tumor progression such as nodular peripheral enhancement as well as atypical findings of local progression, such as intraductal recurrence in the liver and collecting system recurrence in the kidney
3. Appearance of common complications such as vascular thrombosis and bile duct/collecting system injuries as well as uncommon complications such as distal ureteral injury/inflammation

Conclusion: Reviewers of this exhibit will improve their interpretation of post-ablation imaging to better recognize both normal and abnormal imaging findings, improving the care of patients.

Authors: Mauch, S., Hinshaw, J.L., Wells, S., Lubner, M., Laeseke, P., Longo, K., Swietlik, J., Knott, E., Zlevor, A., Lee, F.T., Ziemlewicz, T.

Educational Exhibit Electronic

Ece Meram, MD

PGY3 Diagnostic Resident

Five Stages of Artifacts: Denial, Anger, Bargaining, Depression, and Acceptance

Purpose: Image-guided interventions (such as biopsy, ablation, transarterial embolization, etc) are frequently utilized for diagnostic and therapeutic purposes. Image guidance improves target accuracy and increases the safety of procedures. However, intraprocedural imaging can also be challenging to interpret if the image quality is degraded by artifacts. This exhibit aims to (1) demonstrate different types of artifacts commonly encountered during image-guided interventions, including those guided by ultrasound or x-ray based technologies, (2) highlight common limitations of imaging modalities that can delay or impede interventional procedures, and (3) provide alternative approaches to improve image quality or alternative modalities that can be utilized.

TABLE OF CONTENTS/OUTLINE

- a. Ultrasound-guidance
 - 1. Types of procedures that US can be used with
 - 2. Types of artifacts
 - 3. How to optimize view and alternatives
- b. Fluoroscopy-guidance
 - 1. Types of procedures that fluoroscopy can be used with
 - 2. Types of artifacts
 - 3. How to optimize view and alternatives
- c. Conventional and cone-beam CT-guidance
 - 1. Types of procedures that CT can be used with
 - 2. Types of artifacts
 - 3. How to optimize view and alternatives
- d. Quiz Cases

Authors: E Meram, MD, Madison, WI; C Hoffman; S Periyasamy, BS, MS; M G Kleedehn, MD; O S Ozkan, MD; P F Laeseke, MD, PhD.

Educational Exhibit Electronic

Matthew Petterson, MD

PGY5 Diagnostic Resident

Acronyms and Annual Fees: Understanding Organized Radiology

Presented at: American Roentgen Ray Society Annual Meeting, Virtual, April 19th – April 22nd, 2021

Purpose: Organized medicine has become increasingly fragmented, with proliferation of professional societies and interdisciplinary interest groups related to each medical specialty, including radiology. Given limits on physician time and financial resources, awareness of the diverse array of groups with organized radiology with their differing missions, constituencies, and costs of membership is necessary.

Discussion: More than 40 professional organizations constitute organized radiology within the United States of America, including licensing bodies such as the American Board of Radiology, interdisciplinary organizations with goals related to physician advocacy, medical quality, and education such as the American College of Radiology and the American Roentgen Ray Society, as well as numerous subspecialty societies and interdisciplinary interest groups. Many of these groups hold annual meetings, publish peer-reviewed journals, and require annual membership dues. Radiologists who engage in maintenance of certification activities and hold membership in multiple multispecialty and subspecialty societies may be responsible for annual fees in excess of \$3000 per year.

Conclusion: The plethora of groups within organized radiology creates opportunities for engagement and professional development for all diagnostic and interventional radiologists and nuclear medicine physicians. Understanding the diversity of these groups allows physicians to target their limited time and financial resources to the specific organizations with the greatest relevance to their practices and professional goals.

Authors: Matthew Petterson, MD; Lori Mankowski Gettle, MD, MBA

Scientific Poster Electronic

Matthew Petterson, MD

PGY5 Diagnostic Resident

Team Science, Interdisciplinarity, and Implications for Physician-Scientist Training: A Retrospective Review of 2.6 Million Citations

Presented at: American College of Radiology 2020 Annual Meeting

Purpose: The need for team science and interdisciplinary research has never been greater, with some efforts made to support this type of research. However, little is known about the reach of interdisciplinary research output. To understand the effect of collaborative inquiry and inform future efforts, comparison was made between interdisciplinarity and journal impact factor, commonly used as a surrogate marker for overall reach and quality of published research.

Materials/Methods: The top 15 journals as measured by journal impact factor from each of 10 medical specialties in the year 2014 were identified. Articles published within each journal during the years 2012-2014 were then analyzed to create a categorized report of all subsequent citing publications, utilizing an approach with yielded DIV*, a statistical metric of interdisciplinarity. The data was then pooled, and impact factor and interdisciplinarity were compared.

Results: When examining more than two million citations from the aggregated data, a significant correlation was found between journal impact factor and interdisciplinarity ($t = 0.201$, $p\text{-value} < 0.001$).

Conclusion: Research with implications for multiple specialties or fields tends to relate to increased number of future citations – informing or stimulating future inquiry. Given that interdisciplinary research is particularly impactful, efforts should be made to involve future physician-scientists in team science during their medical training to help provide them with the tools to engage in interdisciplinary research in the future.

Authors: Matthew Petterson, MD, Colin Longhurst, MS, John-Paul Yu, MD, PhD

Scientific Poster Electronic

Matthew Petterson, MD

PGY5 Diagnostic Resident

Team Science and Interdisciplinarity in Radiology and Implications for Radiology Resident Training: a Retrospective Review of 1.0 Million Citations

Presented at: American Society of Neuroradiology 2020 Annual Meeting

Purpose: The need for inter- and cross-disciplinary research has never been greater, in radiology no less than other biomedical fields. However, little is known about interdisciplinary research in radiology. To understand the effect of collaborative research in radiology, comparison was made between interdisciplinarity and journal impact factor, which is frequently used as a surrogate marker for overall reach and quality of published research.

Materials/Methods: The top 125 journals as measured by journal impact factor in the year 2014 from the Web of Science category “Radiology, Nuclear Medicine, and Medical Imaging” were identified. Articles published within each journal during the years 2012-2014 were then analyzed to create a categorized report of all subsequent citing publications, utilizing an approach which yield DIV*, a statistical measure of interdisciplinarity. The data were then pooled, and impact factor and interdisciplinarity were compared.

Results: When examining more than one million article citations from the aggregated data, a significant correlation was found between journal impact factor and interdisciplinarity ($t = 0.26$, $p\text{-value} < 0.001$).

Conclusion: Radiology research with implications for multiple specialties tends to be associated with increased number of future citations, evidencing greater influence on future inquiry. Given that interdisciplinary research is particularly impactful, efforts should be made to engage radiology residents in team science during training to help provide them with the tools to engage in such interdisciplinary research in the future.

Authors: Matthew Petterson, MD, Colin Longhurst, MS, John-Paul Yu, MD, PhD

Scientific Poster Electronic

Matthew Petterson, MD

PGY5 Diagnostic Resident

Correlation between Research Interdisciplinarity and National Institutes of Health Grant Funding of U.S. Radiology Departments

Presented at: American Roentgen Ray Society 2021 Annual Meeting

Purpose: National Institutes of Health (NIH) grant funding is intended to support the most promising and impactful biomedical research currently being performed. However, little is known about the reach of supported research. To understand the link between NIH funding and cross-disciplinary implications of research performed at funded institutions, comparison was made between interdisciplinarity and funding amounts.

Materials/Methods: All institutions receiving NIH funding for grants in the category "Radiation-Diagnostic/Oncology" in the year 2019 were identified. All articles published by authors from the corresponding institutions within the Web of Science category "Radiology, Nuclear Medicine, and Medical Imaging" in the years 2010-2014 were identified. These articles were then analyzed to create a categorized report of all subsequent citing publications, utilizing an approach with yielded DIV* diversity, a statistical metric of interdisciplinarity. Publication interdisciplinarity and NIH funding were then compared.

Results: Sixty-five institutions received NIH grants in the examined category. A total of 53,784 articles were published by the included departments in the corresponding Web of Science category within the studied time period, which were subsequently cited a total of 927,520 times. A positive correlation was found between DIV* diversity and NIH funding ($p = 0.505$), driven predominantly by institutions receiving between \$5 million and \$10 million in grant funding. However, for institutions receiving less than \$5 million or greater than \$10 million in funding, this correlation was not noted.

Conclusions: At intermediate funding levels, increased NIH grant funding was associated with increased interdisciplinarity of research performed at funded institutions. However, institutions with low or high levels of funding produced research with widely varying degrees of interdisciplinarity, suggestive that some institutions are more successful at producing impactful research. Efforts should be made to understand and emulate the approaches of these institutions.

Authors: Matthew Petterson, MD, Colin Longhurst, MS, John-Paul Yu, MD, PhD"

Educational Exhibit Electronic

Jennifer Pitts, MD

PGY3 Diagnostic Resident

Intraoperative ultrasound for procedural guidance during cavernous malformation resection surgery

Presented at: American Society of Neuroradiology Annual Meeting, Virtual, May 22nd – 26th, 2021

Abstract: Intraoperative ultrasound has been previously described as a tool for surgical localization. While utilization remains relatively low, it is most commonly reported for applications in the spine.¹ It is utilized to assist in identifying intramedullary disease which can be difficult to detect upon superficial visual inspection. Additionally, traditional navigation systems are not useful in these scenarios where intraoperative decompression of the CSF and subarachnoid space causes shifts in the parenchyma that precludes confident image registration.

At our institution, we have regularly utilized intraoperative ultrasound for intraoperative navigation during the resection of cavernous malformations from the brain, including both supratentorial and infratentorial locations. The benefits of this adjunct navigation technique includes optimization of a minimally invasive approach to address this non-malignant neoplastic disease. It also affords the surgeon the opportunity to identify an associated developmental venous anomaly that may be occult or difficult to visually identify at the time of resection, reducing the risk of complications.

The goal of this electronic educational exhibit is to present a series of our cases, and describe our techniques and methods

Authors: Jennifer Pitts M.D., Laura Eisenmenger M.D., Anthony Kuner M.D., Lori Gettle-Mankowski M.D., M.B.A.

Educational Exhibit Electronic

Simarjeet Puri, MS3

Medical Student 3

Cystoscopy-assisted Retrograde Repositioning or Retrieval of Ureteral Stents in the Pediatric Population

Presented at: Cardiovascular and Interventional Radiological Society of Europe Annual Meeting, Virtual, September 12th – 15th, 2020

Learning objectives:

1. Learn cystoscopy-assisted retrograde ureteral stent repositioning or retrieval techniques in pediatric population.
2. Understand need for education, communication, and coordination of multiple pediatric teams about techniques offered by IR for ureteral stent repositioning or retrieval when conventional techniques cannot be used.
3. Review traditional techniques for ureteral stent repositioning or retrieval.

Background: Ureteral stents are a commonly used following pyeloplasty, transplant, post-operative ureteral stricture or obstruction, ureteral injury, or external compression. Ureteral stent exchange, repositioning, and removal are most commonly done by Urologists. There are a limited number of cases that Urologist are unable to perform, and IR intervention is required usually via a transrenal antegrade approach. However, there are circumstances where antegrade manipulation is not appropriate, including recent pyeloplasty anastomoses and transplant kidneys. In these circumstances a cystoscopy-assisted retrograde approach can be useful.

Clinical Findings/Procedural Detail:

1. Urology:
 - a. Cannulate urethra with cystoscope and pass into bladder.
 - b. Identify the ureteral orifice.
 - c. Retrograde cannulation of the appropriate ureter with a catheter or wire.
2. Interventional Radiology:
 - a. Remove the cystoscope out over the wire.
 - b. Place a 6 Fr sheath over the wire into the bladder or ureter.
 - c. Place a snare through the sheath and advance up the ureter to the ureteral stent
 - d. Snare the ureteral stent (either proximal or distal depending on desire for repositioning vs retrieval)
 - e. Replace the ureteral stent over the safety wire if needed.

Conclusions: In the pediatric population when antegrade approach is not appropriate, cystoscopy-assisted interventional techniques can be utilized.

Authors: Simarjeet Puri, John Swietlik MD, Trevor Everett MD, Orhan Ozkan MD, Michael Woods MD

Educational Exhibit Electronic

Thomas Reher, MD

Neuroradiology Fellow

High-risk Carotid Atherosclerotic CT Angiography Biomarkers

Presented at: American Society of Neuroradiology Annual Meeting, Virtual, May 22nd – 26th, 2021

Purpose: Worldwide, stroke is the second leading cause of death and large vessel atherosclerosis contributes to up to 25% of cases. Non-contrast head CT and CTA of the head and neck are a common method of initially assessing for stroke. Though MRI has superior soft tissue characterization and provides additional biomarkers of at-risk carotid atherosclerotic plaques, it's longer scan time, decreased accessibility outside of business hours, and prohibitive medical devices/foreign bodies restrict its use in many cases. For these reasons, there has been considerable investigation into CTA surrogate findings that may help to stratify a patient's risk of a carotid source stroke and guide management. The purpose of this educational exhibit is to highlight at-risk atherosclerotic plaque features that a radiologist needs to know and to characterize their clinical significance.

Materials/Methods: We will present imaging of mild, moderate, and severe atherosclerotic stenosis, plaque ulceration as well as CTA rim-sign of intraplaque hemorrhage (IPH) and plaque enhancement as a marker of neovascularization or disrupted fibrous cap. We will touch on the importance plaque composition. In addition, we will describe corollary MRI/MRA findings for CTA plaque characteristics. Results: Owing to its superior spatial resolution, CT allows for plaque volume quantification. CTA outperforms ultrasound for subcomponent characterization (fatty, mixed, calcified) and detecting plaque ulcerations, defects >1 mm deep along the luminal surface. Plaque enhancement requires a pre-contrast scan and follows a previously established threshold of 10 Hounsfield units. Detection of IPH using CT is challenging and conflicting results have been reported; however, there is recent evidence that soft plaque and calcification morphology can predict the presence of IPH and stroke risk.

Conclusion: The implications of calcification volumes and features still remains complex. Multienergy CT offers advanced tissue characterization. CTA imaging can present carotid atherosclerosis biomarkers to aid in stratifying a patient's risk profile for stroke. To guide patient management, radiologists should take steps to optimize imaging protocols and become familiar with these findings.

Authors: Thomas Reher MD (Presenting Author), Anthony Kuner MD, Scott McNally MD, PhD, Jesse Manunga MD , Kevin Johnson PhD, Laura Eisenmenger MD

Educational Exhibit Electronic

Sean Rose, PhD

Former Medical Physics Resident

Applying a New CT Quality Metric in Radiology: How CT Pulmonary Angiography Repeat Rates Compare Across Institutions

Presented at: Radiological Society of North America Annual Meeting, Virtual, November 28th – December 2nd 2020

Purpose: To quantify overall CT repeat and reject rates at five institutions and investigate repeat and reject rates for CT pulmonary angiography (CTPA).

Methods: In this retrospective study, we apply an automated repeat rate analysis algorithm to 103,752 patient examinations performed at five institutions from July 2017 to August 2019. The algorithm identifies repeated scans for specific scanner and protocol combinations. For each institution, we compared repeat rates for CTPA to all other CT protocols. We used logistic regression and analysis of deviance to compare CTPA repeat rates across institutions and size-based protocols.

Results: Of 103,752 examinations, 1,447 contained repeated helical scans (1.4%). Overall repeat rates differed across institutions ($P < .001$) ranging from 0.8% to 1.8%. Large-patient CTPA repeat rates ranged from 3.0% to 11.2% with the odds (95% confidence intervals) of a repeat being 4.8 (3.5-6.6) times higher for large- relative to medium-patient CTPA protocols. CTPA repeat rates were elevated relative to all other CT protocols at four of five institutions, with strong evidence of an effect at two institutions ($P < .001$ for each; odds ratios: 2.0 [1.6-2.6] and 6.2 [4.4-8.9]) and somewhat weaker evidence at the others ($P = .005$ and $P = 0.011$; odds ratios: 2.2 [1.3-3.8] and 3.7 [1.5-9.1], respectively). Accounting for size-based protocols, CTPA repeat rates differed across institutions ($P < .001$).

Conclusion: The results indicate low overall repeat rates (<2%) with CTPA rates elevated relative to other protocols. Large-patient CTPA rates were highest (eg, 11.2% at one institution). Differences in repeat rates across institutions suggest the potential for quality improvement.

Authors: Sean Rose, PhD; Ben Viggiano, BS; Robert Bour, MD; Carrie Bartels, RT (CT); Jeffery P. Kanne, MD; Timothy P. Szczykutowicz, PhD

Educational Exhibit Electronic

Nick Stabo, MD

PGY5 Diagnostic Resident

Factors Contributing to Variability in Duration of CT scans in the Setting of Trauma - Experience at a Single Tertiary Center

Purpose: To analyze the variability in the duration of trauma scan times at our institution, and identify contributing factors impacting the variability in scan time duration.

Methods: 10358 trauma MDCT scans performed between January 2018 and December 2019 were collected. Studies were excluded from analysis if the duration of the scan was greater than 3 hours, leaving the dataset with 10,251 trauma scans. The duration of the scan was quantified using a commercial radiology data aggregation system (Phillips Performance Bridge) query, as the time between the first image and the completion of the last reformat. Additionally, the time from the completion of the last reformat to when the study was marked as reviewed in PACS was quantified.

Mean time and standard deviation for both the exam duration time and the time to the study being marked as reviewed in PACS were calculated for all of the studies. Additionally, potential predictors for exam length variability were evaluated, including the CT technologist performing the study, the time of day (business vs. after hours), the location of the scanner, and whether or not metal artifact reduction algorithm was used. Finally, a subset of full trauma scans consisting of head, spine, chest, abdomen, and pelvis imaging (n=420) was analyzed to determine variability in the setting of complete, similar trauma scans.

Results: There is substantial variability in the duration of the examinations, with an average time of 26:46 \pm 12:48 minutes from the time of the first image to the last reconstruction. Additionally, similar variability was found in the time until the study was marked as reviewed in PACS, with a mean time to review of 12:33 \pm 7:50 minutes .

For complete trauma scans, there is also substantial variability in the duration of the examinations, with an average time of 37:48 \pm 22:37 minutes. Similar variability was found in the time until the study was marked as reviewed in PACS, with a mean time of 14:06 \pm 7:22 minutes.

There was no significant difference between the scan duration or time to a study being marked as reviewed between scans during business hours vs. after hours. Similarly, no significant difference was seen with or without the use of metal artifact reduction reconstruction algorithms or between scanner locations. Finally, while there was variability between the studies scanned by different technologists, the standard deviations showed significant overlap between all technologists.

Conclusions: Substantial variation in trauma scan time and the time until a scan is marked as reviewed in PACS exists. Multiple opportunities for improving efficiency and streamlining workflow exist, particularly using automated solutions.

Authors: Nicholas J. Stabo, John Garrett, Megan Lipford, Sean Rose, Carrie Bartels, Timothy P Szczykutowicz, Meghan G Lubner.

Scientific Poster Electronic

Nick Stabo, MD

PGY5 Diagnostic Resident

Concordance Rate in Adolescent Twins Informs Genetic Basis for Prominent Perivascular Spaces Risk

Presented at: American Society of Pediatric Neuroradiology, Miami, FL, January 10th – 12th, 2020

Purpose: Prominent perivascular spaces (PVS) are a normal anatomical variant also associated with a wide range of neurological conditions. We compared the concordance rate for prominent PVS among monozygotic (MZ) and dizygotic (DZ) twin pairs to infer the genetic and environmental contributions of prominent PVS risk.

Methods and Materials: Magnetic resonance images (MRI) were acquired at 3T from a healthy community sample of adolescents born in Wisconsin and recruited using statewide birth records. 506 monozygotic and same-sex dizygotic twin individuals aged 13-20 were included. A board certified radiologist and a senior radiology resident who were blinded to the zygosity of the twin pairs reviewed 3D T1-weighted images (1 mm slice thickness) for the presence of prominent PVS. Prevalence and concordance rates among MZ and DZ twin pairs were calculated.

Results: 127 (25%) twin individuals had prominent PVS. Males (33%) were more likely than females (18%) to be affected ($p < 0.05$). The proband-wise concordance rate, which denotes co-twin risk, was 83% for monozygotic pairs and 52% for dizygotic pairs.

Conclusion: Cotwins of monozygotic and dizygotic twins with prominent PVS have approximately 3.3- and 2- fold increased risk, respectively, of also having the condition compared with the full sample prevalence rate (25%). The higher concordance rate among MZ twins compared to DZ twins, who on average only share half of genes identical by descent, suggests genetic risk factors play a key role in the development of prominent PVS.

Authors: Zhan Luo; Nicholas Stabo; Andrew Alexander; Aaron Field; H. Hill Goldsmith; Howard Rowley

Educational Exhibit Electronic

Quinn Steiner, MS2

Medical Student 2

Routine Inferior Vena Cava Filter Retrieval: A Cost Minimization Analysis of Loop Snare Versus Rigid Endobronchial Forceps Assisted Retrieval Techniques

Presented at: Cardiovascular and Interventional Radiological Society of Europe Annual Meeting, Virtual, September 12th – 15th, 2020

Purpose: Routine IVC filter (IVCF) retrieval is a common procedure that can be accomplished with different techniques. Loop snare retrieval is common; however, snares are single use and many routine retrievals require more advanced techniques. Rigid endobronchial forceps retrieval is an effective advanced approach with forceps able to be sterilized and re-used for multiple procedures. The purpose of this study was to compare the cost effectiveness of snare versus forceps IVCF retrieval techniques at a single institution.

Materials and Methods: This study is a cost minimization analysis including an IRB approved, single-center, retrospective review of all IVCF retrievals from January 2019 to January 2020. Routine IVCF retrieval techniques were categorized as loop snare-only retrieval (SR), forceps-assisted after unsuccessful snare retrieval (S+F), and forceps-only retrieval (FR). Total equipment cost for each technique was determined.

Results: Thirty-eight successful routine IVC filter retrieval procedures were performed at our institution during the study period (30 SR, 7 S+F, 1 FR). There were no technical failures. FR was the most cost-effective technique with per-procedure equipment cost of SR, S+F, and FR techniques of \$434.30, \$556.55, \$221.98 respectively. Average equipment cost for the 38 retrievals over the study period was \$451.23. Had all retrievals been performed using the FR technique, average equipment cost per retrieval would have been decreased by \$229.25 for a total cost savings of \$8,711.50 over the 12-month study period.

Conclusion: Utilization of FR technique for all routine IVCF retrievals would result in a meaningful cost savings compared to standard SR and S+F techniques.

Authors: Quinn Steiner, John Swietlik MD, Paul Laeseke MD, PhD, and Aaron Eifler MD

Educational Exhibit Electronic

Kyle Werth, MD

Neuroradiology Fellow

Head and Neck Manifestations of Systemic Disease

Presented at: American Society of Neuroradiology, Virtual, May 22nd – 26th, 2021

Purpose: There are numerous multi-systemic disease processes that have imaging findings within the head and neck, which can either be an initial manifestation of a systemic diagnosis or sequelae of a known disease. The imaging findings can be focal or diffuse, and these cases can oftentimes be a diagnostic conundrum for radiologists as many of these diseases can appear very similar to infectious processes. Radiologists can play a pivotal role in the diagnostic work-up and outcomes of patients with underlying systemic illness by recognizing key imaging features and helping to circumvent possible complications or emergencies related to the systemic disease. The purpose of this electronic educational exhibit is to familiarize radiologists with the various imaging presentations of different multi-systemic diseases by utilizing a case-based approach.

Educational Objectives:

Review pathophysiology and imaging findings associated with various multi-systemic disease processes that have manifestations in the head and neck

Review expected patterns of disease that will allow radiologists to look for clues to aid in the diagnostic work-up of a patient with systemic disease

Materials/methods: Case-based approach to reviewing imaging findings seen in the head and neck related to multi-systemic disease

Results: This electronic educational exhibit will review the pathophysiologic issues and imaging findings related to various multi-systemic disease processes, including rheumatologic and mucociliary disease, metabolic and bone disorders, as well as disorders of immunodeficiency and malignancy. More specifically, this exhibit will use a case-based style to review granulomatosis with polyangiitis (GPA), eosinophilic granulomatosis with polyangiitis (EGPA), sarcoidosis, relapsing polychondritis (RPC), amyloidosis, IgG4 immunodeficiency, Gorlin syndrome, Gardner syndrome, cystic fibrosis, McCune-Albright syndrome, Paget's disease, and Kallman's syndrome.

Conclusion: It is imperative for the interpreting radiologist to be aware of imaging findings in the head and neck related to common and uncommon multi-systemic diseases. Accurate recognition of these findings is important for further care of the patient as well as avoiding potential head and neck complications or emergencies that may result if unrecognized. The goal of this exhibit is to educate radiologists on possible head and neck manifestations of multi-systemic disease processes while also reviewing their pathophysiology.

Author(s): Kyle Werth, M.D. & Tabby Kennedy, M.D.

Educational Exhibit Electronic

Ian Wolf, MS2

Medical Student 2

Transradial Arterial Access Vasodilation Cocktail: Is The Calcium Channel Blocker Needed?

Presented at: Society of Interventional Radiology, Virtual, 2020

Purpose: Transradial access (TRA) for arterial procedures in Interventional Radiology (IR) continues to grow in popularity. During IR radial arterial access it is standard to give a cocktail of Heparin, Nitrates, and a calcium channel blocker (Verapamil) through the vascular sheath to prevent arterial vasospasm. However, data within Interventional Cardiology radial access literature questions the need of Verapamil. This study was completed to evaluate the safety, efficacy, and cost of TRA without the use of Verapamil in the vasodilation cocktail at a single institution.

Methods and Materials: Retrospective review of all TRA cases completed in the department of Interventional Radiology at a single institution were reviewed from September 2014 - July 2019. A total of 244 TRA cases were identified. Verapamil was used in the TRA vasodilation cocktail for 32 patients until May 14, 2015. No Verapamil was used for the remaining 212 TRA cases through July 2019. EMR chart review was completed on all procedures to evaluate complication rates and technical success rates. In addition, the average wholesale price of Verapamil was obtained via the vendor.

Results: Technical success rate for TRA completed with and without Verapamil in the vasodilation cocktail were 100% and 98.3% respectively. The two technical failures that occurred in TRA cases without Verapamil were secondary to an anatomical variant of the left radial artery and an inability to cannulate a superselective hepatic artery branch. Neither failure was impacted by the lack of Verapamil. The complication rate from TRA intervention without Verapamil was 0.8%. Both the technical success and complication rates of TRA without Verapamil compare favorably to current literature. The average wholesale price of Verapamil is \$12.60 per 5 mg vial, for a total savings of \$2,671.20 over the time period.

Conclusions: Elimination of Verapamil from TRA showed similar safety, efficacy, and decreased hospital cost for TRA arterial IR interventions.

Authors: Ian Wolf, Charles Viers, MD, John Swietlik, MD, Chadi Diab MD, Michael Woods, MD

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great success!

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