Sunday

Program subject to change until 12/16/2019.

RSNA® 2019
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105TH Scientific Assembly and Annual Meeting
December 1–6 | McCormick Place, Chicago

PS10

Opening Session

Sunday, Dec. 1 8:30AM - 10:15AM Room: Arie Crown Theater

OT

AMA PRA Category 1 Credits ™: 1.75
ARRT Category A+ Credit: 1.25

Participants
Valerie P. Jackson, MD, Tucson, AZ (*Presenter*) Nothing to Disclose
Cynthia H. McCollough, PhD, Rochester, MN (*Presenter*) Research Grant, Siemens AG
Ejaz Rahim-Chaudry, MD, Skokie, IL (*Presenter*) Nothing to Disclose

Sub-Events

PS10A Presentation of the Outstanding Educator Award

Participants
Jocelyn D. Chertoff, MD, Lebanon, NH (*Recipient*) Board of Directors, Varex Imaging Corporation

PS10B Presentation of the Outstanding Researcher Award

Participants
Elizabeth A. Krupinski, PhD, Atlanta, GA (*Recipient*) Nothing to Disclose

PS10C Dedication of the 2019 RSNA Meeting Program to the Memory of William R. Eyler, MD (1918-2018)

PS10D President's Address: A Matter of Perspective: Putting a New Lens on Our Patient Interactions

Participants
Valerie P. Jackson, MD, Tucson, AZ (*Presenter*) Nothing to Disclose
Ronald L. Arenson, MD, Mill Valley, CA (*Presenter*) Scientific Advisory Board, Imagion Biosystems; Consultant, Arterys Inc; Consultant, Ziteo Medical

Abstract

In recent years, the benefit that is gained when radiologists interact directly with their patients has been the subject of increasing discussion. A variety of new developments within radiology - and in medicine in general - make this concept more relevant today than ever. As the issue of physician burnout continues to grow, for example, we begin to recognize that connecting on a human level with our patients can counteract stress by adding deeper meaning to our work. Other trends, such as value-based care, team-based delivery models and the rise of artificial intelligence each add, in their own ways, to a new rationale for radiologists to seek opportunities to reach out more directly to patients. While challenges remain - ranging from high case volumes to an RVU-based compensation system that de-incentivizes increased patient contact - it is in our best interests as radiologists to forge new, more beneficial relationships with those we serve. The key to progress is in changing our perspectives and approaches - toward patients, referring physicians and our own profession - and reimagining new ways of working together.

PS10E Finding the Caring in Care

Participants
Abraham Verghese, MD, Stanford, CA (*Presenter*) Speakers Bureau, Leigh Bureau; Advisory Board, Gilead Sciences, Inc
Valerie P. Jackson, MD, Tucson, AZ (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

In a rapidly changing world with greater intrusion of technology, how do physicians find meaning in their roles? We will look at history and consider the nature of important human rituals in thinking of the path ahead.

SPAI11

RSNA AI Deep Learning Lab: Beginner Class: Classification Task (Intro)

Sunday, Dec. 1 10:30AM - 12:00PM Room: AI Showcase, North Building, Level 2, Booth 10342

AI BR CH CT GI HN IN MR NR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants

Bradley J. Erickson, MD, PhD, Rochester, MN (*Presenter*) Board of Directors, VoiceIt Technologies, LLC; Stockholder, VoiceIt Technologies, LLC; Board of Directors, FlowSigma, LLC; Officer, FlowSigma, LLC ; Stockholder, FlowSigma, LLC

Special Information

In order to get the best experience for this session, it is highly recommended that attendees bring a laptop with a keyboard and decent-sized screen. Having a Gmail account will be helpful. Here are instructions for creating and deleting a Gmail account.

ABSTRACT

This class will focus on basic concepts of convolutional neural networks (CNNs) and walk the attendee through a working example. A popular training example is the MNIST data set which consists of hand-written digits. This course will use a data set we created, that we call 'MedNIST', and consists of images of 6 different classes: Chest X-ray, Chest CT, Abdomen CT, Head CT, Head MR and Breast MRI. The task is to identify the image class. This will be used to train attendees on the basic principles and some pitfalls in training a CNN. • Intro to CNNs • Data preparation: DICOM to jpeg, intensity normalization, train vs test • How do we choose the labels? Inconsistencies... Use Fast.AI routines to classify; Validation of results: Are the performance metrics reliable?; 'Extra Credit': if there is time, explore data augmentation options, effect of batch size, training set size.

SPCT10

Best Clinical Trials @ RSNA 2019

Sunday, Dec. 1 10:45AM - 12:15PM Room: E352

BR GI HP MR NM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Udo Hoffmann, MD, Boston, MA (*Moderator*) Research Grant, Kowa Company, Ltd ; Research Grant, Abbott Laboratories; Research Grant, HeartFlow, Inc; Research Grant, AstraZeneca PLC;
David A. Mankoff, MD, PhD, Philadelphia, PA (*Moderator*) Speaker, Koninklijke Philips NV Consultant, General Electric Company Advisory Board, RefleXion Medical Inc Consultant, Blue Earth Diagnostics Ltd Research Funded, Siemens AG Advisory Board, ImaginAb, Inc Spouse, Owner, Trevarx
Ruth C. Carlos, MD, MS, Ann Arbor, MI (*Moderator*) Editor, Journal of the American College of Radiology; Support, Harvey L. Neiman Health Policy Institute; In-kind support, Reed Elsevier;

Sub-Events

SPCT10A MRI in Addition to Mammography Screening in Women with Extremely Dense Breasts: Primary Outcome of the Randomized DENSE Trial

Participants
Marije F. Bakker, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Grant, Bayer AG; Software support, Volpara Health Technologies Limited
Stephanie V. de Lange, Utrecht, Netherlands (*Presenter*) Research Grant, Bayer AG; Software support, Volpara Health Technologies Limited
Rudolf M. Pijnappel, MD,PhD, Haren, Netherlands (*Abstract Co-Author*) Research Grant, Bayer AG
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Researcher, Siemens AG Researcher, Seno Medical Instruments, Inc Researcher, Identification Solutions, Inc Researcher, Micrima Limited Researcher, Medtronic plc Scientific Advisor, ScreenPoint Medical BV Scientific Advisor, Transonic Imaging, Inc Stockholder, Transonic Imaging, Inc
Claudette E. Loo, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Bob Bisschops, Dordrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Marc Lobbes, MD, Maastricht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Mathijn D. De Jong, MD, 's-Hertogenbosch, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Katya M Duvivier, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Jeroen Veltman, MD, Hengelo, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Wouter B. Veldhuis, MD, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Carla H. van Gils, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Software support, Volpara Health Technologies Limited

ABSTRACT

PURPOSE To evaluate the effect of supplemental MRI for women with extremely dense breasts within a population-based screening program. METHOD AND MATERIALS Between 2011-2015, we randomized 40,373 screening participants (aged 50-75) with a negative screening mammography and extremely dense breasts (ACR category 4 by Volpara software) to (an invitation for) supplemental 3.0-T MRI at 8 sites (intervention arm; n=8,061) or mammography screening only (control arm; n=32,312). The difference in interval cancers after the first (prevalent) screening round, during the two-year screening interval, was investigated by intention-to-treat (ITT) analysis, and by complier-average causal effect (CACE) analysis to account for noncompliance. The performance of the incident screening rounds was investigated as well. RESULTS In the intervention arm, 4,783 (59%) underwent MRI examination. Cancer detection rate was 16.5/1000 screens [95%CI:13.3-20.5]. For this, 9.5% of women were recalled (6.3% with biopsy). Positive predictive values are 17.4% [95%CI:14.2%-21.2%] (recall) and 26.3% [95%CI:21.7%-31.6%] (biopsy). In the intervention arm, cancers were more frequently stage 0-I than in the control arm (82.8% vs 41.6%, p<0.001). With ITT analysis, the interval cancer rate was 4.98/1000 women in the control arm and 2.48/1000 women in the intervention arm, leading to a reduction of 2.50/1000 women [95%CI:0.98-3.71]; p<0.001. With CACE analysis, this reduction was 4.22/1000 women [95%CI:2.01-6.43]. Preliminary results of the incident screening rounds showed that 3,548 women had again undergone (at least one) mammographic screening with a negative result. Supplemental cancer detection rate was 5.3/1000 screens [95%CI:3.4-7.7]. For this, 2.8% [95%CI:2.4%-3.4%] of women were recalled for further diagnostic work-up. At the meeting, results on cost-effectiveness will be presented as well. CONCLUSION Supplemental MRI screening in women with extremely dense breasts results in statistically significantly fewer interval cancers. In subsequent rounds, both the cancer detection rate and the false-positive rate decrease. CLINICAL RELEVANCE/APPLICATION There is a heated debate on the value of supplemental screening in women with dense breasts. The DENSE trial is the first randomized trial on supplemental MRI screening that has been performed in women with dense breasts.

SPCT10B Disscussant for MRI In Addition to Mammography Screening

Participants
Christopher E. Comstock, MD, New York, NY (*Presenter*) Nothing to Disclose

SPCT10C 18F-FDG PET-MR Enterography in Predicting Histological Active Disease in Ulcerative Colitis: A Randomized Controlled Trial Using Nancy Index

Participants
Yan Li, Essen, Germany (*Presenter*) Nothing to Disclose
Benedikt M. Schaarschmidt, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose

Lale Umutlu, MD, Essen, Germany (*Abstract Co-Author*) Consultant, Bayer AG
Michael Forsting, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Aydin Demircioglu, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Anna K. Koch, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Ole Martin, Duesseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
Ken Herrmann, Essen, Germany (*Abstract Co-Author*) Co-founder, SurgicEye GmbH Stockholder, SurgicEye GmbH Consultant, Sofie Biosciences Consultant, Ipsen SA Consultant, Siemens AG Research Grant, Advanced Accelerator Applications SA Research Grant, Ipsen SA
Hendrik Juette, Bochum, Germany (*Abstract Co-Author*) Nothing to Disclose
Andrea Tannapfel, Bochum, Germany (*Abstract Co-Author*) Nothing to Disclose
Jost Langhorst, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose

ABSTRACT

PURPOSE To evaluate the diagnostic performance of PET-MR enterography in detecting histological active inflammation in patients with ulcerative colitis and the impact of bowel purgation on diagnostic accuracies of PET-MR parameters. METHOD AND MATERIALS Fifty patients were enrolled in this randomized controlled trial (clinicaltrials.gov [NCT03781284]). 40 patients were randomized in two study arms, in which bowel purgation was performed either before or after PET-MR enterography. All patients underwent ileocolonoscopy with mucosal biopsies after PET-MR within 24h. Diagnostic performance of MR morphological parameters (MRmorph), diffusion-weighted imaging (DWI) and PET in detecting histological inflammation determined by Nancy index was compared with each other and between study arms. Correlation between PET and histological inflammatory severity was calculated. RESULTS In study arm without previous bowel purgation, SUVmax ratio of bowel segment (relative to SUVmax of the liver) facilitated the highest specificity and diagnostic accuracy compared to MRmorph and DWI. Bowel cleansing led to markedly increased metabolic activity of bowel segments, resulting in significantly reduced specificity of PET compared to study arm without purgation (0.808 vs. 0.966, p = 0.007, respectively). Inter-observer concordance for assessing MRmorph was clearly increased after bowel cleansing (Cohen's κ: 0.847 vs. 0.665, p = 0.013, respectively), though diagnostic performance of MRmorph was not significantly improved. Our findings suggested that the change of metabolic status was mainly associated with the grade of neutrophil infiltrate and less dependent on chronic infiltrate. CONCLUSION PET-MR enterography was an excellent non-invasive diagnostic method in the assessment of ulcerative colitis without the need of previous bowel purgation. CLINICAL RELEVANCE/APPLICATION SUVmaxRatio was a reliable parameter facilitating best diagnostic operating characteristics in predicting histological active disease in patients with ulcerative colitis and no previous bowel purgation was needed for PET-MR.

SPCT10D Discussant for 18F-FDG PET-MR Enterography

Participants
Joel G. Fletcher, MD, Rochester, MN (*Presenter*) Grant, Siemens AG; Consultant, Medtronic plc; Consultant, Takeda Pharmaceutical Company Limited; Grant, Takeda Pharmaceutical Company Limited; ;

SPCT10E Clinical and Cost-Effectiveness Implications of Utilizing Immediate Acute Magnetic Resonance Imaging (MRI) in the Management of Patients with Suspected Scaphoid Fracture and Negative Initial Radiographs: Results from a Randomized Clinical Trial

Participants
Tiago Rua, BSC,MSc, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sanjay Vijayanathan, MBBS, Harrow, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Davina Mak, MBBS, BSC, Middlesex, United Kingdom (*Presenter*) Nothing to Disclose
Alireza Zavareh, MD, FRCR, Bristol, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Amanda Isaac, MBChB, FRCR, Rickmansworth, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Bharti Malhotra, MBA, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Laura Hunter, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Janet Peacock, PhD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
James Shearer, PhD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Vicky J. Goh, MBBCh, Chalfont St Giles, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Paul McCrone, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sam Gidwani, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

ABSTRACT

PURPOSE Given the limited accuracy of radiographs on presentation to the Emergency Department (ED), the management of suspected scaphoid fractures remains clinically challenging and an economic burden to healthcare systems. This trial evaluated the clinical and cost-effectiveness implications of using immediate Magnetic Resonance Imaging (MRI) as an add-on test during the ED attendance for patients with negative findings on the initial radiographs. METHOD AND MATERIALS A pragmatic, randomized, single-center trial compared the use of immediate MRI for patients presenting to the ED with suspected scaphoid fractures against standard care with radiographs only. Participants' use of health services was estimated from primary care and secondary care databases and questionnaires at baseline, 3 and 6 months post-recruitment. Costs were compared using generalized linear models and combined with quality-adjusted life years (QALYs) to estimate cost-effectiveness. RESULTS A total of 136 participants were recruited based on 1:1 ratio, block randomization methods (mean age 37 years; 57% male; 79% full-time employed). 6.2% (4/65, control group) and 10% (7/67, intervention group) of participants sustained scaphoid fractures (p=0.37). 7.7% (5/65, control group) and 22% (15/67, intervention group) of participants had other fractures diagnosed (p=0.019). The use of MRI increased the diagnostic accuracy both in the diagnosis of scaphoid fracture (100.0% vs 93.8%) and any other fracture (98.5% vs 84.6%). Mean (SD) cost per participant up to 3 months post-recruitment was £542.4 (£855.2) for the control group and £368.4 (£338.6) for the intervention, leading to a cost difference of £174 (95% CI -£30 to £378, p=0.094). The cost difference per participant at 6 months increased to £266 (95% CI £3.3 to £528, p=0.047). The MRI intervention dominated standard care costing less and achieving more QALY gains, presenting a probability of 96% and 100% of being cost-effective at month 3 and 6 considering traditional willingness-to-pay thresholds. CONCLUSION The use of immediate MRI in the management of participants with suspected scaphoid fracture and negative radiographs led to significant cost-savings whilst improving and expediting the pathway's diagnostic accuracy. CLINICAL RELEVANCE/APPLICATION The immediate use of MRI in the management of suspected scaphoid fractures should be included as part of standard of care as an add-on test for patients with negative radiographs.

SPCT10F Discussant for Clinical and Cost-Effectiveness Implications

Participants
Garry E. Gold, MD, Stanford, CA (*Presenter*) Research support, General Electric Company

SPCT10G Imaging-guided Target Volume Reduction in Radiotherapy of Lung Cancer: The Prospective Randomized Multinational PET-Plan Trial

Participants
Tanja Schimek-Jasch, MD, Freiburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Ursula Nestle, MD,PhD, Monchengladbach, Germany (*Presenter*) Nothing to Disclose
Stephanie Kremp, DIPLPHYS, Homburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Andrea Schaefer, PhD, Homburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Andreas Kusters, MD, Krefeld, Germany (*Abstract Co-Author*) Nothing to Disclose
Marco Tosch, MD, Wuppertal, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas Hehr, MD,PhD, Stuttgart, Germany (*Abstract Co-Author*) Nothing to Disclose
Martina Eschmann, Stuttgart, Germany (*Abstract Co-Author*) Nothing to Disclose
Yves-Pierre Bultel, Trier, Germany (*Abstract Co-Author*) Nothing to Disclose
Peter Hass, Magdeburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Jochen Fleckenstein, Homburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Alexander Thieme, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Marcus Stockinger, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose
Matthias Miederer, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose
Gabriele Holl, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Christian Rischke, MD, Kirchzarten, Germany (*Abstract Co-Author*) Nothing to Disclose
Sonja Adebahr, MD, Freiburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Eleni Gkika, Freiburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Jochem Koenig, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose
Anca-Ligia Grosu, Freiburg, Germany (*Abstract Co-Author*) Nothing to Disclose

ABSTRACT

PURPOSE Advanced medical imaging offers a chance for target volume reduction in modern radiotherapy, which may lead to more effective local treatments with reduced toxicity and offer the protection of draining lymph nodes and large vessels, possibly of importance for the upcoming combination of radiotherapy and immunotherapy. Locally advanced non-small cell lung cancer (NSCLC) with improvable local control and high toxicity is an excellent model to investigate this topic. METHOD AND MATERIALS In the prospective randomised controlled PET-Plan trial (NCT00697333), patients with inoperable stage II/III NSCLC and an indication for radiochemotherapy were randomized at a 1:1 ratio. In conventional arm A target volumes were informed by FDG-PET and CT plus elective nodal irradiation and in experimental arm B they were solely informed by FDG-PET. In both arms, quality assured isotoxically dose-escalated IMRT or 3D-CRT (60 - 74Gy, 2Gy per fraction) was planned and applied to the respective target volumes along with simultaneous platinum-based chemotherapy. The primary objective was time to locoregional progression (LRP) in terms of non-inferiority of experimental arm B. RESULTS 311 patients were recruited, 205 patients included in the intent to treat (ITT) (A: n=99, B: n=106) and 172 patients in the per protocol (PP) analysis (A: n=84, B: n=88). Median FU time in the PP set was 16 months. Non-inferiority of experimental arm B was confirmed for the pre-specified non-inferiority margin. The risk of LRP was lower in the experimental arm B (2y-LRP 0.20 vs. 0.39; HR=0·57; 95% CI: 0·30-1·06; p=0·039) with no difference between study arms concerning survival (2y-OS 0.57 vs. 0.54), out-field recurrence and toxicity. CONCLUSION In radiochemotherapy for locally advanced NSCLC, PET-Imaging based reduction of radiotherapy target volumes is feasible and may improve local control without increasing toxicity. CLINICAL RELEVANCE/APPLICATION The procedures established in this clinical trial provide a radiotherapy standard for future NSCLC trials including immunotherapy and may furthermore inspire trials on imaging based target volume reduction for other tumor types.

SPCT10H Discussant for Imaging-guided Target Volume Reduction

Participants
Daniel Pryma, MD, Philadelphia, PA (*Presenter*) Research Grant, Siemens AG; Research Grant, 511 Pharma; Research Grant, Progenics Pharmaceuticals, Inc; Research Consultant, Progenics Pharmaceuticals, Inc; Research Consultant, 511 Pharma; Research Consultant, Actinium Pharmaceuticals, Inc; Research Consultant, Nordic Nanovector ASA

SPOI11

Oncodiagnosis Panel: Renal Cell Carcinoma

Sunday, Dec. 1 10:45AM - 12:15PM Room: E353C

OI RO

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants

Anca L. Grosu, MD, Freiburg, Germany (*Moderator*) Nothing to Disclose
Simon S. Lo, MD, Seattle, WA (*Presenter*) Editor, Springer Nature; Member, ICON plc; Member, Elekta AB;
Robert Abouassaly, MD,MSc, Cleveland, OH (*Presenter*) Nothing to Disclose
Joseph I. Clark, MD, Maywood, IL (*Presenter*) Speakers Bureau, Bristol-Myers Squibb Company; Speakers Bureau, Merck & Co, Inc; Spouse, Employee, Bristol-Myers Squibb Company
Sandeep Vaidya, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Andrew D. Smith, MD, PhD, Birmingham, AL (*Presenter*) CEO, AI Metrics LLC ; Owner, AI Metrics LLC ; CEO, Radiostics LLC; Owner, Radiostics LLC; CEO, Liver Nodularity LLC ; Owner, Liver Nodularity LLC ; Research Grant, General Electric Company; Speaker, Canon Medical Systems Corporation; Speaker, AlgoMedica, Inc

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LEARNING OBJECTIVES

1) Describe the diagnostic findings of renal cell carcinoma. 2) Describe the surgical options of renal cell carcinoma. 3) Describe the role of interventional radiology in renal cell carcinoma. 4) Describe the role of stereotactic body radiotherapy in primary and oligometastatic renal cell carcinoma. 5) Describe the role of systemic therapy in renal cell carcinoma.

ABSTRACT

Renal cell carcinoma (RCC) is one of the most common cancers in the developed world. Active surveillance is the standard of care but for patients who are not good surgical candidates, ablative therapies such as RFA and cryotherapy or stereotactic body radiotherapy can be offered. For patients with metastatic RCC, proper selection of systemic therapy and incorporate of focal therapy in appropriate clinical scenarios are crucial. To achieve the best treatment outcome, a multidisciplinary approach is paramount.

SSA01

Breast Imaging (Artificial Intelligence in Screening)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S406A

AI BR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Shandong Wu, PhD, MSc, Philadelphia, PA (*Moderator*) Nothing to Disclose
John M. Lewin, MD, Denver, CO (*Moderator*) Nothing to Disclose

Sub-Events

SSA01-01 Using Deep Learning to Improve Efficiency of Breast Cancer Tomosynthesis Screening

Sunday, Dec. 1 10:45AM - 10:55AM Room: S406A

Participants
Flora Gilboa, Haifa, Israel (*Presenter*) Employee, IBM Corporation
Susan C. Harvey, MD, Lutherville, MD (*Abstract Co-Author*) Consultant, Hologic, Inc; Consultant, IBM Corporation
Lisa A. Mullen, MD, Cockeysville, MD (*Abstract Co-Author*) Nothing to Disclose
Ran Bakalo, MSc, Haifa, Israel (*Abstract Co-Author*) Nothing to Disclose
Ella Barkan, Haifa, Israel (*Abstract Co-Author*) Nothing to Disclose
Yoel Shoshan, Haifa, Israel (*Abstract Co-Author*) Employee, IBM Corporation

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PURPOSE

Digital breast tomosynthesis (DBT) has higher diagnostic accuracy than 2D digital mammography (MG) and is becoming widely available. However, DBT interpretation time, with 200-400 slices per exam, is significantly longer than MG's. Over 90% of screening exams are normal, so automation is desirable. This study explores using deep learning to filter out a portion of the normal DBT studies, allowing radiologists to focus on the more complex cases and improve their efficiency.

METHOD AND MATERIALS

This study was IRB approved and HIPPA compliant. It comprises 5,000 women who presented for screening DBT between 2013 and 2017. The de-identified data set includes prior exams, reaching 12,500 tomosynthesis screening exams accompanied by clinical information. For ground truth, we gathered 2899 screening exams with biopsy performed within 180 days of the screening exam (1064 malignant, 1835 benign) and normal exams that had 2 years follow up. In addition to breast-level labels indicating benign or malignant findings, we labeled the slice number in which the lesion is seen best, the range of slices that the lesion is seen in and graphical annotation overlaid on the 'best' slice. We developed a binary classifier of normal vs. undecided. We used a deep learning network, RetinaNet, utilizing a Feature Pyramid Network backbone, a proven architecture for detecting objects on different scales. We trained this network using the findings annotations, while customizing several aspects of the architecture to handle DBT inputs.

RESULTS

The target was to filter out a portion of the normal exams (i.e. exams without malignant or benign biopsy) keeping a false negative rate that is equivalent to radiologists. Our network succeeds to filter 37% of the normal exams (i.e. 37% specificity) with 97% sensitivity. The area under the ROC curve was 0.84 for this task.

CONCLUSION

By using one of the largest reported tomosynthesis dataset with biopsy-proven results, our study demonstrates the potential of A.I to reduce interpretation workload.

CLINICAL RELEVANCE/APPLICATION

One important practical issue related to DBT implementation is the longer interpretation time. Reducing the workload of reading normal exams can improve radiologist's efficiency.

SSA01-02 A Fully Representative Breast Cancer Screening Population for Validation of AI Algorithms

Sunday, Dec. 1 10:55AM - 11:05AM Room: S406A

Participants
Karin Dembrower, MD, Stockholm, Sweden (*Presenter*) Nothing to Disclose
Erik Wahlin, Stockholm, Sweden (*Abstract Co-Author*) Nothing to Disclose
Edward M. Azavedo, MD, PhD, Stockholm, Sweden (*Abstract Co-Author*) Nothing to Disclose
Mattie Salim, MD, Stockholm, Sweden (*Abstract Co-Author*) Nothing to Disclose
Kevin Smith, Stockholm, Sweden (*Abstract Co-Author*) Nothing to Disclose
Peter Lindholm, MD, PhD, Stockholm, Sweden (*Abstract Co-Author*) Nothing to Disclose
Fredrik Strand, MD,PhD, Stockholm, Sweden (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

AI algorithms are being developed for mammographic breast cancer detection and risk estimation. Algorithms should be validated in independent well-curated datasets. There has been a lack of fully representative datasets until now. Our aim was to provide an accessible infrastructure with a dataset representative of a true geographical screening population.

METHOD AND MATERIALS

From a geographically defined screening cohort of women 40 to 74 years old between 2008 and 2016, we included all first incident cancer cases and a random selection of 10,000 healthy controls. Information was linked between the screening register, the cancer register and the PACS. All screening examinations, with two views of each breast, were included. After data curation all information was anonymized and transferred to local storage. Tumors were annotated at pixel-level. Access to the final dataset has currently been offered to one external research group working on AI CAD for tumor detection. Their algorithm provided one prediction score for each examination.

RESULTS

Our case-control dataset included 1,303 cancer cases (10,732 mammograms) and 10,000 healthy controls (116,048 mammograms). The histological origin of cancer was 70% ductal, 10% lobular and 20% mixed or other. There were 36% invasive-only, 11% in situ-only and 53% mixed cancers. Pixel-level annotations were produced for 898 women (1,891 images). The first validated external algorithm was processed in less than 3 days. It showed an AUC of 0.958 (95%CI: 0.954 to 0.962) using the ground truth of pathologically confirmed diagnosis within 12 months of examination. The level of performance was similar for both invasive and in situ cases.

CONCLUSION

Our comprehensive case-control dataset representative of a true breast cancer screening population was used to validate the first external AI CAD algorithm showing very good accuracy. The dataset will remain available for validation of algorithms from further external research groups.

CLINICAL RELEVANCE/APPLICATION

Having access to a comprehensive dataset representative of a true screening population will improve the ability to train and test AI tools that are clinically reliable.

SSA01-03 Increase of Cancer Detection Rate and Reduction of False-Positive Recall in Screening Mammography Using Artificial Intelligence: A Multi-Center Reader Study

Sunday, Dec. 1 11:05AM - 11:15AM Room: S406A

Participants
Hyo-Eun Kim, Seoul, Korea, Republic Of (*Presenter*) Employee, Lunit Inc
Jung-Yin Huh, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Hye Lee, MD, Bucheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun-Kyung Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess feasibility of artificial intelligence (AI) based diagnostic-support software whether it can be used to improve radiologists' diagnostic performance in terms of cancer detection and false-positive recall in breast cancer screening.

METHOD AND MATERIALS

A total of 400 exams of screening mammograms were retrospectively collected from two institutions. For each institution, 100 cancer, 40 benign, and 60 normal exams were collected. All cancer exams were proven by biopsy. Half of the benign exams were proven by biopsy (i.e. recalled benign) while the remainder were proven by at least 2 years of follow-up imaging. 80% of the exams were randomly selected respectively from each category and each institution (e.g., 16 recalled benign for each institution). All exams were 4-view paired. A blinded multi-reader multi-case study was performed with a group of 14 radiologists for the selected 320 exams. Each radiologist reads each case without and then with aid of Lunit INSIGHT for Mammography (Lunit Inc., South Korea), a deep learning-based software which shows per-breast malignancy scores as well as region-of-interests (ROIs) for suspicious malignant lesions (Fig.1). The difference of readers' decision without and with AI in terms of likelihood-of-malignancy (LOM; DMIST 7-pt score) and recall-ness (recall or not) was analyzed.

RESULTS

Significant improvement of diagnostic performance was shown for all 14 radiologists; average LOM-based ROC AUC was 0.810 and 0.881 without and with AI, respectively (p-value=0.0000047, C.I.=95%). Based on readers' binary decision whether each exam should be recalled or not, average cancer detection rate was increased from 75.3% to 84.8% while false-positive recalls (i.e. non-cancer recalls) were decreased from 28.0% to 25.4% where 20% of non-cancer exams were recalled benign cases.

CONCLUSION

This reader study showed a statistically significant improvement of diagnostic performance (0.071 increase in ROC AUC). Cancer detection rate was increased by 12.6% and false-positive recall rate was decreased by 9.6% with assistance of AI-based diagnostic-support software.

CLINICAL RELEVANCE/APPLICATION

With increase of cancer detection rate and decrease of false-positive recall rate, AI-based diagnostic-support software can be practically used in routine breast cancer screening.

SSA01-04 Can Artificial Intelligence Be Used as a Standalone Technique for Very Low Probability for Malignancy Mammograms?

Sunday, Dec. 1 11:15AM - 11:25AM Room: S406A

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PURPOSE

The purpose of this study was to determine if an Artificial Intelligence (AI) trained algorithm can be potentially used for standalone interpretation of very low probability for malignancy mammograms. It has been shown that the accuracy of AI based algorithms for 2D mammography can match or exceed the accuracy of the average radiologist. This study was performed to evaluate the accuracy of an AI based software (cmTriage, CureMetrix, Inc.) on a large data set of screening mammograms when set to a 99% sensitivity threshold (95% CI = [0.98, 1.0].

METHOD AND MATERIALS

A case based AI base algorithm was used to analyze 1255 screening mammograms obtained from 3 different imaging facilities. The exams were comprised of a blend of cases that had biopsy-confirmed malignant lesions as well as at least two year followup on the non-biopsied cases as validation of benignity. The thresshold of the software was set to 99% sensitivity. The number of cases that were assigned to very low probability of malignancy was calculated and then compared to the final classification of those cases

RESULTS

Out of the pool of screening cases, 40% of the cases were categorized as not suspicious by the algorithm. Comparison with the biopsy and/or long term followup showed that there were no cancers detected in the cases that were categorized as not suspicious by the triage software. In addition, 99% of the biopsy proven cancers were sorted into the suspicious category by the algorithm.

CONCLUSION

The AI based triage software was shown to be accurate in pre-analyzing mammograms and correctly sorted 99% of the malignant cases into the suspicious category and 40% of the non-malignant cases into the non-suspicious category. This suggests that the high sensitivity threshold setting of the AI-based algorithm could potentially be used to eliminate some very low probability of malignancy mammograms from the radiologist worklist

CLINICAL RELEVANCE/APPLICATION

Pre-analysis of mammograms using AI based triage software can potentially enhance radiologist workflow, productivity, and accuracy. Using high sensitivity thresshold, it is possible that AI based software could potentially be used as a standalone to eliminate very low probability for malignancy cases from the radiologist worklist.

SSA01-05 Data-Driven Imaging Biomarker for Breast Cancer Screening in Digital Breast Tomosynthesis: Multi-Domain Learning with Mammography

Sunday, Dec. 1 11:25AM - 11:35AM Room: S406A

Participants
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PURPOSE

To assess feasibility whether mammography data is helpful for developing data-driven imaging biomarker in digital breast tomosynthesis (DIB-DBT; an imaging biomarker for detection of breast cancer, which is derived from DBT data based on deep learning technology).

METHOD AND MATERIALS

A total of 1,517 exams of 4-view digital breast tomosynthesis (DBT) and 49,577 exams of 4-view digital mammograms (MMG) were retrospectively collected from an institution. We divided 1,517 exams of DBT into 1,187 (970 cancer, 52 benign, 165 normal) and 330 (244 cancer, 34 benign, 52 normal) exams for training and validation, and 49,577 exams of MMG into 47,719 (5,599 cancer, 17,971 benign, 24,149 normal) and 1,858 (619 cancer, 620 benign, 619 normal) exams for training and validation, respectively. For external validation, we also collected 448 exams (148 cancer, 150 benign, and 150 normal) of 4-view DBT from another institution. Previously, we demonstrated that using DBT and MMG concurrently is effective for developing DIB-DBT, where it was first trained with (large-scale) MMG then fine-tuned with (small-scale) DBT. We further aimed to enhance the utilization of MMG by multi-domain learning to boost the performance of DIB-DBT. Two-stage training was adopted - 1) pre-training with MMG, followed by 2) multi-domain fine-tuning with both of DBT and MMG. A total of four different approaches was compared in order to find the best way to exploit MMG for developing DIB-DBT - (a) training only with DBT, (b-d) training with MMG and then fine-tuning with (b) DBT (previous work), (c) DBT and MMG, (d) DBT and MMG by multi-domain learning.

RESULTS

Per-exam AUC of DIB-DBT on the internal validation dataset was 0.890, 0.899, 0.901, 0.910 for each method of (a-d) respectively, while per-exam AUC on the external validation dataset was 0.871, 0.880, 0.899, 0.901 for (a-d) respectively. Fig. 1 shows an

example of DIB-DBT (i.e. (d)).

CONCLUSION

This study demonstrated that multi-domain learning with large-scale MMG is an effective way for developing DIB-DBT especially with small-scale DBT. Further clinical validation is needed to utilize DIB-DBT as a reliable diagnostic-support tool for breast cancer detection.

CLINICAL RELEVANCE/APPLICATION

With further clinical validation, DIB-DBT could be practically used as an effective diagnostic-support tool for breast cancer screening in digital breast tomosynthesis

SSA01-06 Data-Driven Imaging Biomarker for Breast Cancer Screening in Mammography: Early Detection of Breast Cancer

Sunday, Dec. 1 11:35AM - 11:45AM Room: S406A

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PURPOSE

To assess feasibility of data-driven imaging biomarker in mammography (DIB-MMG; an imaging biomarker derived from large-scale mammography data based on deep learning technology) whether it can be used for early detection of breast cancer.

METHOD AND MATERIALS

A total of 105,592 exams of 4-view digital mammograms were retrospectively collected from multiple institutions for developing DIB-MMG, where 22,456 were cancer (confirmed by biopsy), 36,821 were benign (confirmed by biopsy or at least 1 year of follow-up imaging), and 46,315 were normal exams. Based on external validation in a separate institution with 3,696 exams of mammograms (1,073 were cancer; one for each patient), DIB-MMG showed 0.963, 94.1%, 80.2% of AUC, sensitivity, specificity, respectively. Among the 1,073 cancer patients, 85 patients had 116 exams of prior mammograms which were diagnosed as non-cancer at that time. A breast radiologist retrospectively reviewed the 116 exams and re-classified into three categories - 1) Missed (46 exams; 47 cancer / 45 non-cancer breasts): retrospectively seen in previous mammogram (mmg-p) and also seen in mammogram at diagnosis (mmg-d), 2) Interval (55; 61/49): retrospectively not seen in mmg-p but seen in mmg-d, and 3) Occult (15; 17/13): not seen both in mmg-p and mmg-d. DIB-MMG was analyzed for the Missed, Interval, and Occult cancers, respectively.

RESULTS

Per-breast AUC, sensitivity, specificity were used since all the data is positive in exam-level. Per-breast AUC was 0.841, 0.676, 0.620 for the Missed, Interval, Occult, respectively. Sensitivity (w/ specificity) at different operating points 0.05, 0.10 were 68.1% (88.9%), 55.3% (91.1%) for Missed, 49.2% (83.7%), 37.7% (91.8%) for Interval, and 41.2% (69.2%), 17.7% (84.6%) for Occult, respectively. Original operating point of DIB-MMG for routine screening was 0.10. Fig.1 shows examples of the Missed and Interval cancers.

CONCLUSION

This retrospective study showed feasibility of DIB-MMG for early detection of breast cancer on mammography, where 32 out of 47 missed cancers, 30 out of 61 interval cancers, 7 out of 17 occult cancers were detected by DIB-MMG. Overall AUC was 0.738. Further clinical validation with observer performance study is needed.

CLINICAL RELEVANCE/APPLICATION

With further clinical validation, DIB-MMG can be used as an effective diagnostic-support tool for early detection of breast cancer in screening mammography.

SSA01-07 Improved Breast Cancer Detection and Reading Time with Concurrent Use of Deep Learning-Based Artificial Intelligence for Digital Breast Tomosynthesis When Interpreted with Digital Mammography versus Synthetic Mammography

Sunday, Dec. 1 11:45AM - 11:55AM Room: S406A

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PURPOSE

To evaluate improvements in accuracy and reading time associated with concurrent use of Artificial Intelligence (AI) with Digital Breast Tomosynthesis (DBT) based on 2D image type combined with DBT.

METHOD AND MATERIALS

Twenty-four (24) radiologists participated in a retrospective reader study with 260 DBT exams, interpreting with Digital Mammography (DM/DBT) in 195 cases, including 43 cancer and 152 non-cancer cases and with Synthetic Mammography (SM/DBT) in 65 cases, including 22 cancer and 43 non-cancer cases. A crossover design was used to read all exams with and without AI with a 4-week washout period. Suspicious soft tissue and calcific lesions were detected in DBT slices by an AI system based on deep convolutional neural networks. Readers were provided detection outlines and 0-100% AI certainty of finding scores. Endpoints included Area Under the ROC Curve (AUC) requiring localization of malignant lesions, sensitivity, specificity and reading time, and were evaluated with AI versus without AI separately for DM/DBT and SM/DBT.

RESULTS

AUC improved for both 2D formats with AI versus without AI: 0.067 increase for DM/DBT (95% CI: 0.026, 0.108) from 0.781 without AI to 0.848 with AI; 0.034 increase for SM/DBT (95% CI: -0.001, 0.070) from 0.812 without AI to 0.846 with AI.Case-level sensitivity improved for both 2D formats with AI versus without AI: 0.092 increase for DM/DBT (95% CI: 0.017, 0.166) from 0.735 without AI to 0.827 with AI; 0.057 increase for SM/DBT (95% CI: 0.011, 0.103) from 0.839 without AI to 0.896 with AI.Specificity improved for both 2D formats with AI versus without AI: 0.080 increase for DM/DBT (95% CI: 0.039, 0.120) from 0.657 without AI to 0.737 with AI; 0.031 increase for SM/DBT (95% CI: -0.028, 0.090) from 0.522 without AI to 0.553 with AI.Reading time was shorter for both 2D formats with AI versus without AI: 29.2 sec with AI and 65.1 sec without AI for DM/DBT; 34.0 sec with AI and 61.2 sec without AI for SM/DBT. Reading time improved 55.1% with use of AI (95% CI: 44.5%, 63.7%) for DM/DBT and 44.4% (95% CI: 31.7%, 54.7%) for SM/DBT.

CONCLUSION

The use of AI with DBT improved AUC, sensitivity, specificity and reading time when reading DBT with digital or with synthetic 2D.

CLINICAL RELEVANCE/APPLICATION

Radiologist's breast cancer detection performance and efficiency improve with concurrent use of AI for DBT with digital or synthetic 2D.

SSA01-08 Artificial Intelligence Detecting Breast Cancer in a Screening Population: Accuracy, Earlier Detection on Prior Mammograms, and Relation with Cancer Grade

Sunday, Dec. 1 11:55AM - 12:05PM Room: S406A

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PURPOSE

To analyze the breast cancer detection accuracy of a deep learning-based artificial intelligence (AI) system in screening mammograms of screen-detected cancers, in their prior exams, and study possible dependencies with cancer grade.

METHOD AND MATERIALS

A total of 2,683 screening mammograms with biopsy-proven screen-detected cancers from the OPTIMAM database were retrospectively collected (1,212 had a prior mammogram available). OPTIMAM contains screening mammograms performed in the UK, where women are invited triennially, and each mammogram is independently read by two radiologists with an approximate recall rate of 4%. Regarding the available histology of the screen-detected cases, 1969 presented invasive cancers and 670 contained DCIS only; 1001 presented high-grade (G3) cancers, 1186 intermediate-grade (G2) cancers, and 314 low-grade (G1) cancers. Each mammogram was analyzed by an AI system (Transpara™, ScreenPoint Medical). The AI system produced a recall decision at different recall rates: 50%, 10%, 4%. Recall rate calibration was established for a typical screening population with another set of independent data. The mammograms in this study were never used to train, validate or test the AI system before. The distributions of recalled mammograms were statistically compared using Pearson's chi-squared test at 95% significance level.

RESULTS

The AI system had a sensitivity for screen-detected cancers of 99.3%, 87.7% and 76.1% at recall rates of 50%, 10%, and 4% respectively. When analyzing prior screening mammograms of screen-detected cancers, 16.8% would have been recalled by the AI system at a recall rate of 4%. There were significative differences when stratifying by cancer grade: at a recall rate of 4%, a greater proportion of the high-grade than low-grade cancers were recalled by the AI (80.7% G3 versus 68.2% G1, $P<0.001$).

CONCLUSION

The AI system achieves a high sensitivity at a recall rate of 50%, meaning that it could discriminate 50% of the screening population as being almost certainly normal, it has potential to detect cancers earlier, while sensitivity is higher for high-grade cancers than for low-grade.

CLINICAL RELEVANCE/APPLICATION

AI systems have great potential to assist radiologists in breast cancer screening by improving efficiency (reduced workload) and/or performance (earlier detection).

SSA01-09 The Effect of Chemoprevention Agents on Convolutional Neural Network-Based Breast Cancer Risk Model Using a Mammographic Dataset

Sunday, Dec. 1 12:05PM - 12:15PM Room: S406A

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PURPOSE

We have previously developed and published a novel convolutional neural network (CNN) derived pixel-wise breast cancer risk model using a mammographic dataset. Purpose of this study is to evaluate whether this risk model is modifiable with known chemoprevention regimen (tomoxifen and aromatase inhibitor therapy).

METHOD AND MATERIALS

An IRB approved study identified 558 high risk patients defined as history of atypia or DCIS diagnosed on core needle biopsy. Of 558 patients, 194 patients (group 1) underwent breast cancer risk reducing chemoprevention regimen (tamoxifen or aromatase inhibitor therapy) for a median of 3 years (range 1 - 5 years). 354 patients (group 2) did not undergo chemoprevention regimen. For each group mammographic dataset was composed of two time points (baseline and follow-up). Mammographic dataset was used for CNN based breast cancer risk prediction based on our previously published study. Briefly, each mammogram was normalized as a map of z-scores and resized to an input image size of 256x256. Then a contracting and expanding fully convolutional CNN architecture was composed entirely of 3x3 convolutions, a total of four strided convolutions instead of pooling layers, and symmetric residual connections. L2 regularization and augmentation methods were implemented to limit over-fitting. Statistical analysis was performed comparing group 1's risk reduction following chemoprevention regimen predicted by our CNN risk model compared to group 2 which did not undergo chemoprevention regimen.

RESULTS

Using our CNN based breast cancer risk model, the 194 patients in the treatment group (group 1) showed 20.5% in absolute risk reduction and 32.5% in relative risk reduction. 364 patients in the non-treatment group (group 2) showed 3.5% in absolute risk reduction and 6.5% in relative risk reduction. The absolute risk reduction and relative risk reduction between group 1 and group 2 were statistically significant (p=0.01 and p=0.001).

CONCLUSION

Our CNN based algorithm can predict breast cancer risk, and is modifiable with known chemoprevention regimen.

CLINICAL RELEVANCE/APPLICATION

Potential effectiveness of breast cancer chemoprevention agents may be assessed utilizing our CNN based risk prediction model based on mammographic images.

Printed on: 10/29/20

SSA02

Breast Imaging (MRI Diagnostics)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S402AB

BR MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

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Sub-Events

SSA02-01 High-Risk Lesions Detected by MRI-Guided Core Biopsy: Upgrade Rates at Surgical Excision and Implications for Management

Sunday, Dec. 1 10:45AM - 10:55AM Room: S402AB

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PURPOSE

To assess clinical and imaging characteristics of high-risk lesions detected by MRI-guided core biopsy and to evaluate upgrade rates to carcinoma at surgical excision

METHOD AND MATERIALS

A retrospective review was performed for all women presenting to an academic breast radiology center for MRI-guided biopsy from January 2015 - November 2018. Histopathological results from each biopsy were extracted, and high-risk lesions [atypical ductal hyperplasia (ADH), lobular carcinoma in situ (LCIS), atypical lobular hyperplasia (ALH), radial scar, papilloma, flat epithelial atypia (FEA), and benign vascular lesion] were included for analysis. Clinical history, imaging characteristics, surgical outcome following excision, and follow-up data were also recorded. If the lesion was excised in a mastectomy specimen or a lumpectomy specimen with a known cancer, then upgrade status was deemed indeterminate and not included in the upgrade rate calculation. Rigorous radiologic pathologic correlation was performed of upgraded lesions to determine whether biopsy results were concordant and the lesion was adequately sampled.

RESULTS

Of 810 MRI-guided biopsies, 189 biopsies (23.3%) met inclusion criteria as high-risk lesions. Excluded were 151 (18.6%) malignant and 470 (58.0%) benign lesions. Mean patient age of the included patients was 58.4 years (range 30-83). Upgrade rate was indeterminate in 41 (21.7%) of high-risk lesions. Surgical upgrade rates were high for ADH 32.4% (12/37) and FEA 100.0% (2/2); moderate for LCIS 7.0% (3/43); and low for ALH 0.0% (0/10), radial scar 0.0% (0/24), papilloma 0.0% (0/29), and benign vascular lesions 0.0% (0/3). Of the upgraded lesions, 82.4% (14/17) had concurrent breast carcinoma (7 contralateral and 7 ipsilateral), and 76.5% (13/17) were upgraded to DCIS or well-differentiated carcinoma. ADH was significantly more likely to be upgraded than non-ADH lesions ($p<0.0001$).

CONCLUSION

ADH obtained on MRI-guided core biopsy warrants surgical excision. Other high-risk lesions, however, may be candidates for imaging follow-up rather than surgical excision, especially in the setting of no concurrent breast carcinoma, and after meticulous radiologic-pathologic correlation.

CLINICAL RELEVANCE/APPLICATION

Identifying subsets of high-risk lesions biopsied under MRI-guidance that are rarely upgraded to carcinoma at surgical excision can safely prevent many women from undergoing surgery.

SSA02-02 Tumor Necrosis at Baseline Dynamic Contrast Enhanced (DCE) MRI for Prediction of Neoadjuvant Chemotherapy Treatment (NACT) Response in Triple Negative Breast Cancer (TNBC) Patients

Sunday, Dec. 1 10:55AM - 11:05AM Room: S402AB

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PURPOSE

To determine the predictive value of tumor necrosis at baseline DCE-MRI on treatment response to NACT in TNBC patients.

METHOD AND MATERIALS

This IRB-approved study includes 85 patients with stage I-III TNBC, who had baseline MRI, underwent NACT followed by definitive surgery. Tumors were segmented on the early phase subtraction of DCE-MRI. Necrosis was identified as non-enhancing intra-tumoral tissue on DCE with high T2 signal and shine through on the Apparent Diffusion Coefficient (ADC). Necrotic tumors were segmented with and without inclusion of necrotic regions. The longest dimension of the tumors, volume and percent of necrosis were calculated from contours. Metrics of necrosis were compared with pathologic complete response (pCR) or non-pCR in tissue evaluated after surgical resection, T stage of the tumor, and regional lymph node (LN) involvement at staging and at surgery (positive vs negative). Receiver operating characteristic (ROC) curves, Wilcoxon rank sum tests, and odds ratios (OR) were used for analysis.

RESULTS

Necrosis was seen in 31 pts (36.5 %), median volume was 4.8 cm3 (range 0.7-945 cm3), median percent was 22.8 % (range 4.6-86 %). pCR occurred in 37 pts (43.5%). There was no significant association between pCR and presence of necrosis (OR = 1.4, 95% CI (0.6, 3.3), P=0.49). The volume and percent of necrosis were not significantly different between pts with pCR and non-pCR [AUROCC = 0.52, 95% CI (0.40, 0.65); p=0.69; AUROCC = 0.54, 95% CI (0.41, 0.66) p = 0.52, respectively]. No significant association between T stage of the TNBC and presence of necrosis [OR = 2.3, 95% CI (0.6, 8.8) p = 0.23] was found. Necrotic lesions were seen in 21% (3/14) T1 lesions, 39% (17/44) T2 and 37% (10/27) T3-T4 lesions. There was no significant association between baseline necrosis and LN involvement at staging or at surgery [OR = 0.9, 95% CI = (0.4, 2.1), p= 0.73; OR = 0.5, 95% CI = (0.1, 1.4), p=0.16 respectively]. Tumor necrosis was seen in 38% (15/39) LN+ and in 35% (16/46) LN- pts at staging; 41% (26/64) LN+ and 24% (5/21) LN- pts at surgery.

CONCLUSION

Tumor necrosis at baseline in TNBC patients was not associated with pCR or nodal involvement and was not a predictor of response to NACT.

CLINICAL RELEVANCE/APPLICATION

Our study found that tumor necrosis at baseline imaging in TNBC patients had no association with their treatment response and therefore should not affect their treatment planning.

SSA02-03 Feasibility of Supine MRI-Navigated Ultrasound in Breast Cancer Patients

Sunday, Dec. 1 11:05AM - 11:15AM Room: S402AB

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PURPOSE

To evaluate the feasibility of image fusion between ultrasound (US) and supine magnetic resonance (MR) in breast cancer patients and to evaluate the differences in tumor location between prone and supine positions.

METHOD AND MATERIALS

This prospective study was approved by our institutional review board, and informed consent was obtained. Between May 2016 and December 2017, 88 patients who were undergoing additional supine MR (MRsup) following routine prone MR (MRpro) for breast cancer were included. Clockwise location of the tumor and discrepancies in the distances from nipple to lesion (NLD), skin to lesion (SLD), and lesion to chest wall (CLD) were evaluated between MRpro and MRsup (MRpro-sup), MRpro and MRsup navigated US (MRpro-USnav) and MRsup and USnav (MRsup-USnav). Associations between breast thickness and measurement discrepancies were analyzed using Pearson's correlation.

RESULTS

Total 91 index lesions were evaluated in 88 patients. The intraclass correlation coefficients (ICCs) for the clockwise location of MRpro and MRsup compared with USnav were 0.994 (range: 0.990-0.996) and 0.998 (range: 0.996-0.998), respectively. The mean MRpro-sup and MRpro-USnav measurement discrepancies were greater than those of MRsup-USnav. NLD showed the smallest mean MRsup-USnav measurement discrepancy. Most outer locations showed greater mean measurement discrepancies than inner locations, and each NLD, SLD, and CLD mean measurement discrepancy showed different tendencies according to location and lesion depth. High breast thickness showed significantly greater mean measurement discrepancies than low breast thickness (cutoff: median thickness of 74 mm). Breast thickness showed moderate and strong correlations with MRpro-sup ($r=0.583$, $p<0.001$) and MRpro-USnav ($r=0.634$, $p<0.001$) CLD discrepancies, and weak correlations with MRpro-sup ($r=0.347$, $p=0.001$) and MRpro-USnav ($r=0.343$, $p=0.001$) NLD discrepancies.

CONCLUSION

Image fusion between US and supine MR is feasible in breast cancer patients, although there is a considerable difference in tumor location measurements between prone and supine positions, especially with thicker breasts.

CLINICAL RELEVANCE/APPLICATION

Supine MRI-navigated US is feasible, and the error range between supine and prone position is predictable and may be helpful for estimating breast cancer location and surgical planning.

SSA02-04 Usefulness of MRI Projection Mapping System for Conserving Surgery of Breast Cancer: Comparison with Conventional Method and Pathohistological Findings

Sunday, Dec. 1 11:15AM - 11:25AM Room: S402AB

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PURPOSE

Conserving surgery of breast cancer is conventionally performed by referring MRI acquired in the prone position owing to its accurate detection of the tumor extent. However, the shapes of breast and cancer during MRI scan differ from those under surgery, because the surgery is performed in the supine position. The aim of this study was to evaluate usefulness of MRI projection mapping system (PMS), which we have developed as a prototype, for determining the tumor extent and surgical line in patients who underwent conserving surgery of breast cancer.

METHOD AND MATERIALS

Eleven patients with invasive breast cancer were enrolled. Contrast-enhanced breast MRI in the prone and supine positions was performed separately using a 1.5 T. Conserving surgery of breast cancer was performed based on the conventional method: its extent was determined by palpation, ultrasonography (US) and prone MRI. Immediately before the surgery, maximum intensity projection (MIP) image generated from supine MRI was projected onto the breast surface using structured light method by the MRI-PMS, which consisted of projector-camera system and personal computer. We compared the tumor location and associated intraductal component between the conventional method, MRI-PMS and pathohistological findings.

RESULTS

MRI projection mapping was successfully completed in 9 of the 11 patients; an operational failure occurred in 2 patients. The discrepancy of tumor location ranged from 3 to 9 mm (mean, 4.5 mm) between the conventional method and MRI-PMS. The 5 patients had intraductal component.. The intraductal component was visualized more clearly and perceived more easily by MRI-PMS than by the conventional method in the 4 of them. The total tumor extent defined by MRI -PMS corresponded to that by pathohistological findings in these patients.

CONCLUSION

MRI-PMS visualizes the breast cancer, especially that with intraductal component. Thus, MRI-PMS can be recommended for

conserving surgery of breast cancer.

CLINICAL RELEVANCE/APPLICATION

MRI projection mapping system is useful for conserving surgery of breast cancer because it visualizes the breast cancer well, especially that with intraductal component.

SSA02-05 Accelerating Acquisition of RESOLVE-DWI with Simultaneous Multi-slice (SMS) Technique in Diagnosing Breast Lesions

Sunday, Dec. 1 11:25AM - 11:35AM Room: S402AB

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PURPOSE

To investigate the feasibility and effectiveness of diffusion weighted imaging (DWI) using Simultaneous Multi-slice readout-segmented echo planar imaging (rs-EPI) to diagnose breast lesions.

METHOD AND MATERIALS

The IRB approved study was performed on a 3T scanner with a dedicated 16-channel phased-array breast coil (MAGNETOM Skyra, Siemens Healthcare, Erlangen, Germany). 46 female patients (average age of 42.3 years; range of 26-57 years) with 48 lesions (41 malignant and 7 benign) were enrolled in this study. Patients underwent bilateral breast MRI using a prototypical SMS rs-EPI sequence and a conventional rs-EPI sequence. T1-weighted MRI, T2-weighted MRI, and dynamic contrast-enhanced (DCE-MRI) were also conducted as references. The details of imaging parameters of both DWI sequences were listed in Figure 1. ADC, MK, MD values were quantitatively calculated for each lesion on both sequences. In addition, all images were qualitatively analyzed by a blinded read using a 5-point scale (1 = poor, 5 = excellent). The difference and correlation of both quantitative and qualitative parameters between conventional rs-EPI and SMS rs-EPI data were statistically analyzed.

RESULTS

Compared to conventional rs-EPI, The acquisition time of SMS rs-EPI was markedly reduced (2:17 vs4:27 minutes). The Pearson's correlation showed a excellent linear relationship for each parameter between SMS rs-EPI and conventional rs-EPI ($r = 0.935$, 0.914 and 0.965 for MK, MD and ADC respectively; $P<0.01$ for all, Fig.2). Furthermore, the ROC analysis demonstrated SMS rs-EPI had better diagnostic performance than conventional rs-EPI, however the values didn't differ significantly (Fig.3). In blinded read, SMS rs-EPI showed comparable imaging quality with conventional rs-EPI (Fig.4&5), with moderate to good inter-rater reliability (ICC = 0.63-0.83).

CONCLUSION

Compared to conventional rs-EPI technique, SMS rs-EPI can markedly reduce the acquisition time and yield similar diagnostic accuracy and comparable image quality, which may be useful to expand the scope of its clinical application in breast imaging, and increase the patient throughout.

CLINICAL RELEVANCE/APPLICATION

SMS RESOLVE allows for rapid realization of breast MR imaging, which may serve as a superior alternative for the diagnosis of breast lesions.

SSA02-06 Quantitative Tumor Volumes by Fast Dynamic Contrast Enhanced (DCE) MRI Predict Pathologic Complete Response (pCR) to Neoadjuvant Chemotherapy (NACT) in Triple Negative Breast Cancer (TNBC)

Sunday, Dec. 1 11:35AM - 11:45AM Room: S402AB

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PURPOSE

In TNBC, non-pCR has high risk of recurrence. We evaluated the dependence of the quantitative tumor volumes for predicting pCR status in TNBC on the temporal resolution of DCE MRI.

METHOD AND MATERIALS

In the ARTEMIS trial (NCT02276443), TNBC pts receive 4 cycles of Adriamycin-based chemo (C4AC) followed by taxane-based NACT. 35 pts underwent fast DCE-MRI with range of temporal resolution 8-49 s at baseline (BL) and after C4AC. A retrospective cohort (RC) of 50 TNBC pts who had NACT and BL standard DCE-MRI (temporal resolution 90-120 s) was compared. For all pts pCR was assessed at surgery. 3-dimensional tumor measurements were obtained and tumor volume was contoured by a breast radiologist on the early subtraction phase. Clinical tumor volume (CTV) was calculated using 3 tumor dimensions. Enhanced tumor volume (ETV) was extracted as volume of the contoured voxels, and functional tumor volume (FTV) was extracted as the subset of ETV with voxels below preset signal enhancement ratio (SER). CTV, ETV, FTV, and their changes between BL and C4AC scans were compared between pCR and non-pCR using Receiver Operator Characteristic (ROC) curve and Wilcoxon rank sum test.

RESULTS

An optimal SER of 0.45 was found to maximize AUC of pCR vs non-pCR in ARTEMIS group. In ARTEMIS pts, CTV, ETV, and FTV at BL were able to discriminate pCR and non-pCR, with the pCR pts having significantly smaller tumor volumes (AUC = 0.75, 0.74, 0.74 and p=0.0096, 0.022, 0.022, respectively). CTV, ETV, and FTV at C4AC were significantly different between pCR and non-pCR (AUC = 0.71, 0.74, 0.75 and p=0.041, 0.017, 0.019, respectively). The changes in CTV, ETV, and FTV from BL to C4 were significantly different between pCR and non-pCR (AUC = 0.70, 0.73, 0.71 and p=0.044, 0.026, 0.038). In contrast, CTV, ETV, and FTV in the RC at BL were not significantly different between pCR and non-pCR pts (AUC=0.62, 0.54, 0.53 and p=0.16, 0.66, 0.74 respectively). Tumor volumes measured in ARTEMIS pts were smaller than in the RC (p=0.061).

CONCLUSION

Quantitative tumor volumes measured by fast DCE may serve as an early predictor of treatment response in TNBC. Standard DCE MRI with lower temporal resolution may overestimate the tumor volumes.

CLINICAL RELEVANCE/APPLICATION

Tumor volumes measured with fast DCE MRI improve prediction of treatment response to NACT in TNBC in comparison with standard DCE MRI and may be useful imaging biomarkers of treatment response.

SSA02-07 Efficacy of 3-D Diffusion Weighted Imaging with Background Suppression (DWIBS) in Detection of Breast Carcinoma Compare to Dynamic Contrast Enhanced MRI

Sunday, Dec. 1 11:45AM - 11:55AM Room: S402AB

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PURPOSE

Aim is to evaluate the efficacy 3-D Diffusion weighted imaging with background suppression in detection of breast carcinoma. To evaluate efficacy of DWIBS in differentiation of malignant and benign breast lesions and it's comparison with CEMR.To evaluate ADC values of benign and malignant breast lesions.

METHOD AND MATERIALS

Study IRB and IEC approved.Study included 103 breast lesions which were detected on mammography and breast ultrasound. All the cases underwent breast MRI on 1.5 Tesla machine using dedicated breast coil. Multiplaner localizer applied with 3mm slice thickness. T1WI, T2WI and STIR in axial, STIR coronal, & sagittal plane. Axial DWI was done with b value 1500 sec/mm2. Pre contrast fat-suppressed T1W gradient echo images were obtained followed by intravenous contrast injection. Post processing was done by digitally subtracting the pre-contrast.ADC calculations obtained.All the cases were correlated histopathologically.

RESULTS

Study included 103 lesions.Lesions which showed diffusion restriction considered positive whereas lesions did not show restriction were considered as benign lesions. DWI with increase b value demonstrates lesions better with background suppression. Total 52(50.5%) lesions were benign and 51(49.5%) were malignant on Histopathology. Sensitivity of DWI was 90.2% (95% CI= 84.5,95.9), specificity was 94.2% (95% CI =89.7,98.7), PPV 93.9% 95% CI =89.3,98.5) and NPV 90.7% (95% CI =85.1,96.3). Mean ADCs of malignant lesions was 0.933 ± 0.21× 10 3 mm 2/s. and benign lesions was 1.847 ± 0.51 × 10 3 mm2/s. Area under curve was 0.97. with P value <0.001(significant).Cut off ADC value was 1.08 × 10 3 mm2. Sensitivity for the CEMR was 94.3 %(95% CI= 88.7-99.8),specificity 96.9% (95% CI= 92.7-100.0) PPV 97.1 95% CI =93,100) and NPV 93.9 95% CI =82.2,99.6).

CONCLUSION

DWIBS is an excellent non contrast investigation which can detect breast carcinoma and differentiate benign and malignant breast lesions and the result was comparable to CEMR technique.It can diagnose skin changes and nipple areolar changes as well.

CLINICAL RELEVANCE/APPLICATION

DWIBS can be use as non invasive, non radiation, non contrast method for differentiation in benign and malignant pathology and number of biopsy can be reduced in the clear benign pathologies . This method can be use in the screening of the high risk and dense breast parenchyma,younger population.

SSA02-08 Power of Time-dependent Diffusion MRI as a Prognostic Biomarker in the Breast

Sunday, Dec. 1 11:55AM - 12:05PM Room: S402AB

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PURPOSE

To investigate the utility of ADC values obtained with the different diffusion times (including short diffusion time recently available on clinical scanners) for differentiation of benign and malignant breast tumors as well as their prognostic biomarkers.

METHOD AND MATERIALS

200 cases were prospectively enrolled to this IRB-approved study and 149 breast lesions (86 malignant, 63 benign) were analyzed. DWI scans with prototype sequences using different diffusion times (effective diffusion time Deff = 5.1 ms and 96.6 ms) were performed, with b-values of 0 and 700 s/mm2 and acquisition time of 2.5 min for each on a 3T MRI. ADC change was calculated; (ADCshort - ADClong) / ADCshort x 100 (%), where ADC short and ADC long are ADC values with Deff = 5.1 ms and 96.6 ms. ADC values and ADC changes were compared between malignant and benign breast tumors, as well as between positivity and negativity in expression of their prognostic biomarkers.

RESULTS

Significantly smaller ADCshort and ADClong values were found in malignant compared than benign lesions ($P < 0.0001$ and < 0.0001). ADClong had significantly lower values than ADCshort, both in malignant and benign lesions ($P < 0.0001$ and < 0.0001, respectively). ADC changes were significantly larger in malignant compared with benign lesions ($P < 0.0001$). PgR-positive breast cancers had significantly lower ADCshort and ADClong values than PgR negative ($P < 0.01$ and < 0.05). Both ADCshort and ADClong values were significantly lower in ER-positive than ER-negative breast cancers ($P < 0.05$ and < 0.05). Significantly larger ADC change was observed in Ki-67 positive compared to Ki-67 negative cancers ($P < 0.01$). ADC decrease with diffusion times was remarkable in the peripheral region of typical invasive ductal carcinoma, while center had almost no ADC change, suggesting of central necrosis.

CONCLUSION

ADC values significantly changed depending on tumor types or prognostic factors of breast cancers. Time-dependent diffusion MRI might be a useful prognostic and predictive biomarker, allowing more accurate diagnosis and a safe promising approach to personalized therapy of breast cancer. Our results also underline the importance of checking diffusion times in the interpretation of breast DWI.

CLINICAL RELEVANCE/APPLICATION

The diffusion time dependence of ADC values can be a prognostic marker, potentially allowing to tailor treatment plans of breast cancers without the need of contrast agents

SSA02-09 Feasibility Study of Applying Simultaneous Multi-slice Technique in Diffusion-weighted Imaging of Breast Lesions

Sunday, Dec. 1 12:05PM - 12:15PM Room: S402AB

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PURPOSE

To evaluate the feasibility of applying simultaneous multi-slice (SMS) single-shot echo planar imaging (EPI) to accelerate MR diffusion imaging for breast lesions.

METHOD AND MATERIALS

60 patients (30 breast carcinoma,17 fibroadenoma of breast and 13 normal breast) who underwent breast MRI (3T,MAGNETOM Skyra,Siemens Healthcare) were collected.The following three different diffusion weighted imaging (DWI) scan protocols were applied.The first sequence(A) is the conventional single-shot echo planar DWI (EPI-DWI):TR/TE 5200ms/72ms,FOV 360mm×227.4mm,Slice thickness 5mm,Distance factor 1mm,Slices 30,Bandwidth 1644Hz/pix,Voxel size 0.9×0.9×5mm3,GRAPPA factor 2,b-values(averages) 50s/mm2(2) and 800s/mm2(6) with 3-scan trace mode,Scan time 2:31min.For the second(B) and the third(C) DWI protocols,a SMS factor of two and three were applied, respectively.In order to compare the image quality with those acquired by sequence A,all the sequence parameters were kept the as described above, except for changing the TR of sequence B to 2600ms(scan time 75s) and the TR of sequence C to 1800ms(scan time 55s).For all sequences,image quality is evaluated by two radiologists blinded to the acquisition schemes on a five-point scale.The quantitative analysis for the three sequences included image signal-to-noise ratio (SNR),ADC values of normal breast parenchyma and breast lesions.Paired t-test was used to compare the differences of SNR and ADC values between A and B,A and C.Inter-reader reliability was analyzed by calculating the intra-class correlation coefficient (ICC).

RESULTS

Compared with protocol A, the image quality of protocol C was significant reduced (ICC=0.4), while that of protocol B was stable (ICC= 0.9). The image SNR of A, B and C scan protocols were 21.2±3.0, 19.8±3.3 and 15.3±3.7, respectively. There was no significant difference between protocol B and A (p=0.162) of the image SNR. The SNR of protocol C were significant lower than those of protocol A(p<0.001). The ADC values (×10-3mm2/s) of normal breast parenchyma, breast carcinoma lesions and fibroadenoma of breast were 2.01±0.35, 0.98±0.25, 1.78±0.36, respectively. With SMS factor of 2, the ADC values of those three parts were 1.98±0.39,1.02±0.21,1.82±0.33. The ADC value of 3×SMS were 1.83±0.27,0.87±0.31, 1.87±0.27,respectively.There was no significant difference in ADC values between protocol B and A,C and A in normal breast parenchyma and lesions (all p > 0.05).

CONCLUSION

By applying SMS technique with a factor of 2,the acquisition time of breast DWI can be significantly reduced without sacrificing the image quality.However, if the SMS factor increases to 3,the image SNR decreases which affects clinical diagnosis.

CLINICAL RELEVANCE/APPLICATION

Comparing with conventional EPI-DWI,the SMS markedly Reduces the diffusion scan time and the image SNR still shows a good quality.Thus,SMS technique is recommended for DWI of the MR breast study.

Printed on: 10/29/20

SSA03

Science Session with Keynote: Cardiac (Coronary Artery Disease - Practice and Prognosis)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S105AB

CA CT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

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Sub-Events

SSA03-01 Cardiac Keynote Speaker: Prognostic Role of Coronary CT Angiography

Sunday, Dec. 1 10:45AM - 11:05AM Room: S105AB

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SSA03-03 Small Whole-heart Volume Predicts Major Adverse Cardiac Events in Non-obstructive Coronary Artery Disease: Insights from the PROMISE Trial

Sunday, Dec. 1 11:05AM - 11:15AM Room: S105AB

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PURPOSE

To investigate the predictive value of 3D whole heart volume (WHV) for major adverse cardiovascular events (MACE) in patients with stable chest pain and nonobstructive coronary artery disease (CAD).

METHOD AND MATERIALS

Among participants of the Prospective Multicenter Imaging Study for Evaluation of Chest Pain (PROMISE), we included those with nonobstructive CAD on cardiac computed tomography (CT). WHV was defined as pericardial sac volume excluding the epicardial fat, measured on non-contrast cardiac CT, and indexed to body surface area (iWHV) (Figure A). We determined the association of iWHV with traditional cardiovascular risk factors, coronary artery calcium (CAC), and MACE (all-cause death, myocardial infarction, unstable angina) over a median follow-up of 26 months. In a subgroup, we correlated the iWHV with measures of left-ventricular (LV) function and morphology and systemic inflammation (IL-6).

RESULTS

In 1,134 patients (63±9 years; 43% women), the mean iWHV was 294.3±65.6 cm3/m2. Remarkably, smaller iWHV was associated with female sex and individual CV risk factors (P<0.05 for all) but not with CAC score (Figure B). Similarly, smaller iWHV was associated with MACE, an association that persisted after adjustment for cardiovascular risk and CAC (HR (per decrease of one standard deviation) = 6.7; 95%CI:2.1-19.9; P=0.001) (Figure C). In the subgroup analysis of mechanistic determinants, iWHV correlated moderately with end-diastolic volume (EDV) (r=0.52), stroke volume (SV) (r=0.36), LV-mass (r=0.51) and weakly with LV-ejection fraction (EF) (r=-0.14), LV-mass/volume ratio (r=-0.07) and inflammation (IL-6; r=-0.21) (all correlations P<0.05). Notably, those with the smallest iWHV (i.e., first quintile) had preserved LV-EF (mean: 56.6±7.3%), no LV hypertrophy (mean iLV-

mass: 51.1±8.9 g/m2) or LV dilation (mean EDV: 57.2±12.0 ml/m2).

CONCLUSION

In patients with nonobstructive CAD and without clinical signs of heart failure, smaller iWHV was associated with MACE independent of traditional risk factors and CAC and correlated with smaller LV volumes, higher LV-mass/volume ratio, and increased inflammation.

CLINICAL RELEVANCE/APPLICATION

Given prior evidence linking nonobstructive CAD to coronary microvascular dysfunction and heart failure with preserved EF (HFpEF), we generate the hypothesis that iWHV may represent an early marker of HFpEF.

SSA03-04 Coronary Atherosclerosis in Apparently Healthy Master Athletes Discovered During pre-PARTECIPATION Screening: Role of Coronary CT-Angiography (CCTA)

Sunday, Dec. 1 11:15AM - 11:25AM Room: S105AB

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PURPOSE

To assess the role of Coronary CT-Angiography (CCTA) and non-invasive detection of coronary atherosclerosis (cATS) in the assessment and clinical management of master athletes (MA) during the pre-participation screening (PPS). To assess the role of Coronary CT-Angiography (CCTA) and non-invasive detection of coronary atherosclerosis (cATS) in the assessment and clinical management of master athletes (MA) during the pre-participation screening (PPS).

METHOD AND MATERIALS

We retrospectively examined 167 MA who underwent CCTA in our hospital since 2006, analyzing symptoms, stress-test ECG, cardiovascular risk profiles (SCORE) and CCTA findings.

RESULTS

Among the whole enrolled population, 153 (91.6%) MA underwent CCTA for equivocal/positive stress-test ECG with/without symptoms, 13 (7.8%) just for clinical symptoms, 1 (0.6%) for the family history. The CCTA showed the presence of cATS in 69 MA (41.3%), congenital coronary anomalies (anomalous origin or deep myocardial bridge) in 8 (4.8%), both in 7 (4.2%). A negative CCTA was observed in 83 MA (49.7%). The risk-SCORE (age, hypertension, hypercholesterolemia, smoking) was a good indicator for the presence of moderate/severe cATS on CCTA. However, mild/moderate cATS was present in 17.8% of MA clinically stratified at a low risk-SCORE.

CONCLUSION

CCTA may be helpful in the PPS of MA with an abnormal stress test ECG and/or clinical symptoms engaged in competitive sports with a high cardiovascular involvement, while the invasive coronary angiography is more indicated in athletes with positive stress-test ECG and high clinical risk. Age, gender, presence of symptoms and clinical risk-SCORE assessment may help sports-physicians/cardiologists to decide whether to request a CCTA or not.

CLINICAL RELEVANCE/APPLICATION

CCTA may be helpful in the PPS of MA with an abnormal stress test ECG and/or clinical symptoms engaged in competitive sports with a high cardiovascular involvement.

SSA03-05 Impact of Diabetes on Coronary Artery Disease Progression in Selective Percutaneous Coronary Intervention-treated patients: Using Serial CCTAs

Sunday, Dec. 1 11:25AM - 11:35AM Room: S105AB

Participants
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PURPOSE

Diabetes mellitus (DM) patients have been known to be susceptible to coronary artery disease (CAD). However, the impact of diabetes on plaque progression in CAD patients treated with selective percutaneous coronary intervention (PCI) has been rarely reported. Hence, the present study aimed to evaluate the impact of DM on CAD progression in selective PCI treated patients using serial coronary computed tomography angiography (CCTA), compared against non-diabetic patients.

METHOD AND MATERIALS

A total of 98 patients (age: 69.9 ± 11.0, 83.7% male) referred for selective PCI performed underwent serial CCTAs, which were arranged within one month before PCI and at least 6 month after PCI in our hospital were consecutively analyzed. All the subjects were categorized into diabetes group (36) and non-diabetes group (62). For all the CCTA scans, quantitative measures including segment involvement score(SIS), segment stenosis score(SSS) at baseline and follow-up CCTA, and CCTA-verified plaque progression were evaluated blindly to clinical data and compared between the two groups.

RESULTS

No statistical differences were found in baseline SSS (DM:6(IQR:3.25-8) vs. Non-DM:4(IQR:2-10), P=0.195) or SIS(DM:3(IQR:2-4) vs. Non-DM:2(IQR:1-4), P=0.298). During the median 1.5 year inter-scan period, significant difference was observed in ΔSIS (DM: 0(IQR:0-1) Vs. non-DM: 0 (IQR:0-0.25), P=0.029), ΔSSS (DM:2(IQR:0-3) vs. Non-DM: 0 (IQR:0-2);P<0.001) and Annulaised ΔSSS (0.64(IQR:0-1.83) vs. non-DM:0 (IQR:0-0.75),P=0.004) between the two groups.At per-segment level, compared to non-diabetes, proximal segments(P=0.003), noncalcific plaques(P=0.014) and original normal segments(P=0.005) of diabetic patients were more susceptible to plaque progression(PP). Multivariate logistic regression showed that DM (OR:5.52; 95%CI:1.67-16.48, P=0.005) and chest pain at baseline (OR:5.24; 95%CI:1.67-16.48, P=0.008) were independently associated with CAD progression after adjusting for confounding factors.

CONCLUSION

In the present study, more CCTA-verified progressive plaques were found in diabetes patients after PCI. DM, combined with baseline chest symptom, can further enhance the ability to identify patients who require a therapeutic strategy to halt disease progression.

CLINICAL RELEVANCE/APPLICATION

The present study provides an important opportunity to advance the understanding of the relationship between diabetes and CAD progression in stented patients.

SSA03-06 Artificial Intelligence-Based Coronary CT Fractional Flow Reserve Applied to Triple-Rule-Out CT Angiography in Acute Chest Pain

Sunday, Dec. 1 11:35AM - 11:45AM Room: S105AB

Participants
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PURPOSE

In this study, we evaluated the additional value of noninvasive artificial intelligence (AI)-based CT-FFR, derived from triple-rule-out coronary computed tomography angiography (TRO-CTA) for acute chest pain (ACP) in the emergency department (ED) setting.

METHOD AND MATERIALS

This retrospective, HIPAA-compliant, single-center study was approved by the university's institutional review board. AI-based, deep-learning CT-FFR (Siemens Healthineers) from TRO-CTA datasets was obtained in 159 of 271 (59%) eligible patients (89 men; mean age 57.0±9.7 years) presenting to the ED with ACP. The agreement between CT-FFR (<=0.80) and stenosis on TRO-CTA (>=50%), as well as downstream cardiac diagnostic testing was investigated. Furthermore, the predictive value of CT-FFR for coronary revascularization and major adverse cardiac events (MACE) was assessed over a one-year follow-up period.

RESULTS

CT-FFR and TRO-CTA demonstrated agreement in severity of CAD in 70% (111/159) of all cases. CT-FFR <=0.80 served as a better predictor for coronary revascularization and MACE than >=50% stenosis on TRO-CTA (hazard ratio [HR] 4.1; 95% confidence interval [CI] 1.5-11.4 vs. HR 2.3; 95% CI 0.9-6.0) (p<0.01). Additional diagnostic cardiac testing was performed in 59% (94/159) of patients and included single-photon emission computed tomography (SPECT) (n=62), stress echocardiography (n=31), and stress magnetic resonance imaging (MRI) (n=1). In this subgroup there was higher agreement as to the presence/absence of significant disease with CT-FFR (55%; 52/94) than with coronary TRO-CTA (47%; 44/94) (p<0.01). Reserving downstream testing for patients with CT-FFR <=0.80 would have reduced the number of additional downstream cardiac examinations by 47%.

CONCLUSION

CT-FFR derived from TRO-CTA was a better predictor for coronary revascularization and MACE and showed better agreement with additional diagnostic testing than TRO-CTA. Therefore, CT-FFR may improve the specificity in identifying ACP patients with significant CAD in the ED setting and reduce unnecessary downstream testing.

CLINICAL RELEVANCE/APPLICATION

AI-based CT-FFR derived from TRO-CTA datasets provides additional diagnostic and prognostic value in the evaluation of patients presenting to the ED with chest pain may reduce subsequent downstream testing.

SSA03-07 Combined Assessment of Myocardial Volume and Myocardial Blood Flow for Diagnosis of Obstructive Coronary Artery Disease in Cardiac Computed Tomography

Sunday, Dec. 1 11:45AM - 11:55AM Room: S105AB

Participants
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PURPOSE

The purpose of this study was to evaluate the diagnostic performance of combined assessment of myocardial volume and myocardial blood flow (MBF) for detecting obstructive coronary artery disease (CAD) by cardiac computed tomography (CT).

METHOD AND MATERIALS

A total of 36 patients, who underwent coronary CT angiography (CTA), dynamic stress myocardial CT perfusion (CTP), and invasive coronary angiography (ICA) with invasive fractional flow reserve (FFR) measurement, were enrolled. 256-slice CT (Philips Healthcare, Cleveland, USA) was used in this study. Severe stenosis (stenosis >=70%) and moderate stenosis (50-69%) with FFR <=0.8 on ICA were defined as obstructive CAD. All CTP and CTA data were analyzed by a commercially available workstation (Synapse Vincent ver.5, Fujifilm Medical Systems, Japan). CT-MBF was calculated by deconvolution analysis from dynamic stress CTP images, and coronary artery-related left ventricular myocardial volume (LVMV) on CT was automatically segmented using Voronoi algorithm-based myocardial segmentation. Then, the stenosis-related CT-MBF and LVMV (stenosis >=50% on CTA) were quantified using the image fusion of CT-MBF and the coronary artery territory mapping. Diagnostic performance of the combined assessment of the stenosis-related CT-MBF and LVMV was assessed, and compared with that of stenosis-related CT-MBF alone using the area under receiver operating characteristic curve (AUC).

RESULTS

Of 108 vessels in 36 patients, 65 vessels were suspected of significant stenosis in CTA. Sensitivity and specificity for identifying obstructive CAD were 87% and 60% for stenosis-related CT-MBF, and 87% and 77% for combined assessment of the stenosis-related CT-MBF and LVMV, respectively. The AUCs were 0.79 for the stenosis-related CT-MBF, and 0.89 for combined assessment of stenosis-related CT-MBF and LVMV. The AUC of combined assessment of stenosis-related CT-MBF and LVMV was significantly higher than that of stenosis-related CT-MBF alone ($p < 0.05$).

CONCLUSION

Stenosis-related LVMV could improve the diagnostic performance of CT-MBF for detecting obstructive CAD.

CLINICAL RELEVANCE/APPLICATION

The stenosis-related LVMV has influence on the severity of CAD as well as CT-MBF, and provides the incremental value for detecting obstructive CAD to the stenosis-related CT-MBF.

SSA03-08 Myocardial Blood Flow Analysis of Stress Dynamic Myocardial CT Perfusion for Hemodynamically Significant Coronary Artery Disease Diagnosis: The Clinical Value of Relative Parameter Optimization

Sunday, Dec. 1 11:55AM - 12:05PM Room: S105AB

Participants
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PURPOSE

To investigate the optimal relative parameter of quantitative myocardial blood flow (MBF) on dynamic myocardial CT perfusion (CTP) for the detection of hemodynamically significant coronary artery disease (CAD).

METHOD AND MATERIALS

A total of 86 patients who were prospectively recruited underwent adenosine triphosphate-stress dynamic myocardial CTP. The MBF value was measured by a manually drawn volume of interest (VOIs) on the MBF color-coded polar maps with perfusion defects of vessel-based territory. The relative MBF perfusion parameters were then calculated as Ratio1, Ratio2 and Ratio3 according to the three types of reference MBF values, respectively: 1) average segmental MBF value, 2) 75th percentile of the average segmental MBF value, and 3) highest segmental MBF value. All the data were derived from both the endocardial and transmural

layers of the myocardium. Invasive coronary angiography and fractional flow reserve (ICA/FFR) were used as the reference standards for myocardial ischemia evaluation.

RESULTS

151 vessels of 60 patients (43 men and 17 women; 61.38±8.01 years) were enrolled in the analysis. The performance of endocardial layer was superior to that of the transmural layer (all P <0.05). The Ratio3 of endocardial myocardium (AUC=0.906, 95% CI: 0.857-0.954), for which the highest segmental value was selected as the reference MBF, was superior to both Ratio1 and Ratio2 for ischemia detection (AUC, 0.906 vs. 0.879, P <0.05; 0.906 vs. 0.891, P =0.18), and the sensitivity, specificity, PPV, NPV and diagnostic accuracy were 74.1%, 93.6%, 87.8%, 85.3% and 86.1%, respectively. The cutoff value of Ratio3 was 0.675.

CONCLUSION

The relative MBF parameter of the endocardial myocardium using the highest segmental MBF value as a reference provided optimal diagnostic accuracy for the detection of hemodynamically significant CAD.

CLINICAL RELEVANCE/APPLICATION

The relative MBF perfusion parameters are promising assessment in stress dynamic myocardial CT perfusion (CTP) for myocardial ischemia evaluation, the investigation of optimal relative MBF analysis method not only helps in improving the CTP diagnostic accuracy, but also can further promoting the standardization of CTP technology.

SSA03-09 A Radiomics Approach to Predict Myocardial Fibrosis on Coronary Computed Tomography Angiography in Hypertrophic Cardiomyopathy

Sunday, Dec. 1 12:05PM - 12:15PM Room: S105AB

Participants
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PURPOSE

To evaluate the usefulness of surrogate biomarkers as predictors of myocardial fibrosis in hypertrophic cardiomyopathy using radiomics data from coronary computed tomography angiography (CCTA).

METHOD AND MATERIALS

Between January 2018 and March 2019, consecutive 50 inpatients with hypertrophic cardiomyopathy (HCM) who simultaneously underwent CCTA (Somatom Force, Siemens Healthineers) and cardiac magnetic resonance (CMR) (Ingenia 3.0T, Philips) within 5 days were retrospectively enrolled. Late gadolinium enhanced (LGE) of magnetic resonance imaging (MRI) was used as reference standard for differentiation of non-fibrosis and fibrosis segment. All segments were drawn automatically using a prototype (Cardiac function, Frontier, Siemens) in three dimensions according to AHA 17-segment model and were randomly assigned into a training cohort (n=583, 70%) and a testing cohort (n=267, 30%). 1226 features were generated using a Radiomics prototype (Frontier, VB10, Siemens), and minimum redundancy maximum relevance (mRMR) feature ranking were applied to select useful features in the training cohort. A radiomics signature model was then built by multivariate logistic regression analysis to differentiate between fibrosis and non-fibrosis segment using a prototype (Radiomics, Frontier, Siemens). The area under curve (AUC) value was calculated from a ten-fold validation for evaluation. The prediction performance was tested on the testing cohort.

RESULTS

A total of 850 segments were analyzed, among which 312 (36.7%) segments were diagnosed of fibrosis according to MRI. 10 radiomics features were selected by mRMR, showing significant association with myocardial fibrosis (p<0.05). Based on the multivariate logistic model, our radiomics signature incorporating 9 features (squareroot_ngtdm_Busyness , exponential_glrlm_RunEntropy , wavelet-HHL_gldm_DependenceVariance, etc.) showed good discrimination in the training cohort (AUC 0.82) and test cohort (AUC 0.75 , sensitivity 0.61 , specificity 0.82).

CONCLUSION

Our radiomics model provided a robust complementary tool for the diagnosis of myocardial fibrosis on CCTA, that may facilitate clinical decision-making for patients who are diagnosed of HCM.

CLINICAL RELEVANCE/APPLICATION

Coronary CTA provided a robust complementary tool to CMR in detecting myocardial fibrosis in hypertrophic cardiomyopathy and is recommended in the evaluation of patients who are contraindicated for MRI.

SSA04

Cardiac (Myocardial Ischemia and Viability (MRI))

Sunday, Dec. 1 10:45AM - 12:15PM Room: S102CD

CA MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Susan K. Hobbs, MD,PhD, Pittsford, NY (*Moderator*) Nothing to Disclose

Sub-Events

SSA04-01 Intracoronary Compared with Intravenous Bolus tirofiban on No-Reflow Phenomenon in Patients with ST-Segment Elevation Myocardial Infarction Undergoing Primary Percutaneous Coronary Intervention: A Cardiac Magnetic Resonance Study

Sunday, Dec. 1 10:45AM - 10:55AM Room: S102CD

Participants
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PURPOSE

The aim of the study was to investigate potential effect of intracoronary administration of glycoprotein IIb/IIIa inhibitor tirofiban on no-reflow phenomenon (NR) assessed by CMR compared to intravenous routine in patients with ST-segment elevated myocardial infarction undergoing primary percutaneous coronary intervention (PCI).

METHOD AND MATERIALS

120 patients were randomized into 2 groups (Tirofiban i.c. Versus i.v.). CMR was completed within 3-7 days after ST-segment elevation myocardial infarction. CMR was also performed in 3 to 6 months follow up after discharge. Left ventricular function, volumes, infarct size, microvascular obstruction, hemorrhage, myocardial salvage, myocardial perfusion index and tissue tracking strain were performed on CMR analysis.

RESULTS

The microvascular obstruction (32/52 versus 24/68, $p < 0.05$) showed significantly difference between the intravenous and the intracoronary tirofiban groups. The area at risk (34.4% [interquartile range: 9.0% to 62.4%] versus 33.5% [interquartile range: 8.9% to 50.5%], $p > 0.05$) and infarct size (17.8% [interquartile range: 9.3% to 25.5%] versus 16.8% [interquartile range: 8.8% to 24.3%], $p > 0.52$) did not differ significantly between the two groups. The myocardial salvage index was similar (22.4% [interquartile range: 8% to 43%] versus 21.6% [interquartile range: 7% to 42%], $p > 0.05$). No significantly difference was found in myocardial perfusion index, myocardial strain between the two groups. The intracoronary tirofiban group was associated with higher %ΔLVEDV compared with intravenous group (-9.41% [interquartile range: -13.5% to -2.41%] versus -0.09% [interquartile range: -7.7% to 7.37%], $p<0.01$).

CONCLUSION

This CMR study in ST-segment elevation myocardial infarction patients showed benefit of decreasing MVO for intracoronary tirofiban administration compared to intravenous in patients undergoing PICC. Intracoronary tirofiban administration showed improvement in left ventricular remodeling. No benefit was found with respect to infarct size, myocardial perfusion index and myocardial strain 3-6 months after infarction.

CLINICAL RELEVANCE/APPLICATION

Intracoronary tirofiban administration could be potentially applied to reduce MVO incidence compared to intravenous in STEMI patients undergoing PICC.

SSA04-02 Assessment of Early Left Ventricle Myocardial Strain with Cardiovascular Magnetic Resonance Feature Tracking: A Prospective Study in Patient of Acute ST-elevated Myocardial Infarction

Sunday, Dec. 1 10:55AM - 11:05AM Room: S102CD

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PURPOSE

To investigate the diagnostic performances of early left ventricular (LV) strain, using a cardiovascular magnetic resonance feature tracking (CMR-FT) technology, in patients with acute ST-elevation myocardial infarction (STEMI) after primary percutaneous coronary intervention (PPCI).

METHOD AND MATERIALS

Seventy-eight patients of acute STEMI underwent CMR imaging at 2-6 days after successful PPCI. The imaging protocol included conventional cine imaging, for assessing LV regional radial (RS), circumferential (CS), longitudinal (LS) strains as well as function, and late gadolinium enhancement for assessing LV infarct size, transmurality and microvascular obstruction (MVO). LV strain were analyzed in a 16-segment model.

RESULTS

Hyperenhancement was detected in 495 (40%) of 1248 segments, including 423 (85%) transmural hyperenhancement, and was accompanied by MVO in 173 (35%) of hyperenhancement segments. Regional radial (RS) and circumferential strain (CS) were significantly diminished in segments with hyperenhancement and decreased even further if MVO was also present ($p<0.001$). CS surpassed RS in its ability to differentiate between transmural and non-transmural infarct ($p<0.001$ and $p=0.002$, respectively). Furthermore, CS was superior to RS in discriminating infarcted segments with MVO from infarcted segments without MVO (all $p<0.001$).

CONCLUSION

Regional strain analysis performs ability in differentiating between non-infarcted myocardium, infarcted myocardium with and without MVO, transmural and non-transmural infarcted myocardium. Peak circumferential strain is the most accurate marker of regional function.

CLINICAL RELEVANCE/APPLICATION

Strain shows great potential in noninvasive diagnosis of early LV regional infarct, transmurality, and MVO in patient of acute STEMI. CMR-FT may provide a useful tool in early assessment of myocardial strain.

SSA04-03 Impact of Ischemia Time on Cardiac Functional and Structural Parameters: CMR Assessment and Histological Correlation in a Porcine Model of Myocardial Infarction

Sunday, Dec. 1 11:05AM - 11:15AM Room: S102CD

Awards
Trainee Research Prize - Fellow

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PURPOSE

The pig model of myocardial infarction (MI) is considered the gold standard for the analysis of cardioprotective/regenerative strategies before moving towards the clinical setting. However, there is no systematic study investigating cardiac structural and functional outcomes in relation to the duration of the ischemic insult. We have evaluated the impact of time of ischemia in cardiac damage and performance over time by CMR.

METHOD AND MATERIALS

Pigs (N=32) underwent MI by closed chest balloon occlusion of the mid-left anterior descending (LAD) coronary artery. Animals were randomized into four groups differing in the duration of ischemia (30, 60, 90, and 120min) and then reperfused. A sham-operated group was performed (N=8). The impact of ischemia was assessed by serial CMR at days 3 and 42 post-MI. The following parameters were determined: global and regional function, wall edema, necrosis, and microvascular obstruction. Molecular markers of fibrosis and myocyte hypertrophy were determined in the ischemic myocardium.

RESULTS

At day3, CMR revealed that cardiac damage and function was similar in sham and pigs subjected to 30min ischemia. In contrast, edema and necrosis significantly increased from 60min onwards with a progressive trend over time. Microvascular obstruction was most extensively seen in animals with >=90min of ischemia. These structural alterations associated to a significant and comparable drop in systolic function in pigs subjected to >=60min ischemia (p=60min of ischemia (p=60min of ischemia (p=60min ischemia (P<0.05 vs 30min). At day42 scar size followed the same pattern and systolic and diastolic volumes significantly increased in animals subjected to 60min ischemia, with the worst performance in animals having 120min of ischemia ($p<0.05$ vs. day 3 and 30min ischemia). Gene and protein levels of fibrosis-related markers (collagens and vimentin) were significantly and similarly enhanced in

the infarcted myocardium of pigs subjected to 60min or longer ischemia (P<0.05 vs 30min). The same was true for myocyte surface and volume extension.

CONCLUSION

Mid-LAD coronary occlusion for 60min suffices to induce cardiac structural and functional alterations amenable to therapeutic interventions.

CLINICAL RELEVANCE/APPLICATION

There is a need to standardize methodological approaches of MI-induction in human-like animal models to successfully translate preclinical benefits into the clinical arena.

SSA04-04 Early Detection of Myocardial Fibrosis by CMR Quantitation Extracellular Volume Fraction in a Hypertensive Swine Model

Sunday, Dec. 1 11:15AM - 11:25AM Room: S102CD

Participants
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PURPOSE

Our study aims to determine whether ECV and Native T1 quantified by cardiac magnetic resonance (CMR) can demonstrate left ventricle (LV) extracellular interstitial fibrosis in a hypertensive (HTN) swine model and quantitatively evaluate the dynamic change over time.

METHOD AND MATERIALS

Twenty-five adult male Chinese miniature pigs aged 6-12 months underwent cardiac MR imaging at three time points: pre- and 1 month-, 3 months- post induction of hypertension. Native T1 value and ECV fraction was prospectively performed at all imaging time points. The left ventricle (LV) systolic function was calculated using the cine images. Individual and segmental native T1 value and ECV fraction were compared to the late gadolinium enhancement (LGE) images. Animals were euthanized after the last examination of MRI. Histopathologic examinations of heart were performed later.

RESULTS

The systolic/diastolic pressure was gradually increased. There was no obvious abnormal performance in the triphenyl tetrazolium chloride (TTC) stain and no obvious increased signal intensity in the LGE in all stages of hypertension. However, the ECV fraction and Native T1 value increased with modelling time ($p < 0.001$). The results were demonstrated by pathological results where fibrous tissues were observed increasing gradually in the HE, Masson and Picrosirius stain.

CONCLUSION

T1 and ECV derived from CMR may be a non-invasive method in the early detection of myocardial interstitial fibrosis in hypertensive heart disease prior LGE detectable by conventional CMR. T1 and ECV can also reflect the severity of myocardial involvement in the progress of hypertension. For detection of myocardial fibrosis, combined both advantages of native T1(higher sensitivity) and ECV(higher specificity) can make a more accurate evaluation of myocardial fibrosis.

CLINICAL RELEVANCE/APPLICATION

The presence of diffuse fibrosis may be a potential mechanism for increasing cardiovascular risk in HTN patients. Early detection and taking methods to reduce diffuse fibrosis can reduce the incidence of such risk.

SSA04-05 The Relationship between Systolic and Diastolic Strains Measured from Tissue Tracking Cardiovascular Magnetic Resonance and Adverse Remodeling in Post-STEMI Patients

Sunday, Dec. 1 11:25AM - 11:35AM Room: S102CD

Participants
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PURPOSE

Adverse left ventricle (LV) remodeling was supposed to be the main culprits of ST-segment elevation myocardial infarction (STEMI) patients' poor life quality. This study aimed to determine associations between the diastolic strains rate and adverse LV remodeling in post-STEMI patients.

METHOD AND MATERIALS

A number of 52 (M/F: 46/6, age: 54.27 yrs) STEMI patients who underwent coronary intervention three months ago were prospectively recruited from 2016 to 2017. Follow-up was done until 2018. The primary end points were the symptoms of heart failure (NYHA II-IV). Consent was acquired from each patient and 3.0 T MRI was arranged. Adverse LV remodeling defined by a 12%

increase in LV end diastolic volume (LVEDV). The early (EDSR) and late (LDSR) peak diastolic strain rates were derived from the two peak points on the corresponding curve of time-to-SR curve in the diastole (Figure 1). t-test was performed when comparing between groups. Logistic regression test was done for statistical analysis and $P < 0.05$ was considered as significant.

RESULTS

Myocardial infarction size, all the peak strains, systolic peak strain rates and the early diastolic strain rates were significantly correlated with Adverse LV remodeling. None of the parameters was independent determinant. 23/52 (44.2%) patients complained of heart failure symptoms at the one-year follow-up. Multivariate Logistic regression test showed that only the ratio between the EDSR and LDSR in the radial direction on the short axis (DSRR-SR) was the independent predictor of the heart failure symptoms (6.59; range, 6.71-3.68; P=0.026).

CONCLUSION

Both systolic and diastolic strains were correlated with Adverse LV remodeling at short-time follow-up for STEMI patients, while only the DSRR-SR could independently predict heart failure at the long-time follow-up. The quantitative measurement of diastolic function through myocardium strains might help with better clinical management for STEMI patients.

CLINICAL RELEVANCE/APPLICATION

This study gave clues that myocardium deformation was associated with adverse LV remodeling at the early stage for post-STEMI patients. Furthermore, the diastolic strain rates could potentially provide unique prognostic information for STEMI patients to predict heart failure.

SSA04-06 Ectopic Fat Deposition in Obese Patients with Type 2 Diabetes: Correlation with Left Ventricle Function and Microcirculation

Sunday, Dec. 1 11:35AM - 11:45AM Room: S102CD

Participants
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PURPOSE

To investigate the relationship between microvascular dysfunction and ectopic fat deposition in type 2 diabetes mellitus (T2DM) patients with preserved ejection fraction.

METHOD AND MATERIALS

Forty-eight T2DM patients (23 males, age 56.23±10.65) and fifteen healthy volunteers were prospectively enrolled. All of them were underwent CMR (3.0-T, Siemens Medical Solutions, Erlangen, Germany). Patients with LVEF< 55% were excluded, and all the patients were divided into obesity group (BMI>=24) and non-obesity group(BMI<24). All CMR parameters were measured using the cine sequence and perfusion imaging. Single-voxel H-magnetic resonance spectroscopy was performed to detect the triglyceride content of myocardial (Interventricular septum), liver(segment VII) and muscle(The erector spinae of the same level as the liver), which was calculated as a percentage relative to the signal of myocardial water by the post-processing software (jMRUI, version 6.0).

RESULTS

All patients remained normal LV function and LV global stress compared with normal controls(P>0.05). Myocardial triglyceride content was significantly higher in T2DM patients compared with healthy volunteers (1.41±0.65% vs. 0.61±0.22%, P<0.001). Compared with non-obesity group, triglyceride content of heart and liver were increased in obese group (all P<0.05). Myocardial triglyceride content was correlated with left ventricle mass (r=0.52), Upslope (r=-0.53) and TimeMax (r=0.49), and liver triglyceride content was correlated with Upslope (r=-0.33) and TimeMax (r=0.43). ROC analysis revealed that sensitivity and specificity were obtained for predicting the occurrence of TimeMax with the Myocardial triglyceride content (AUC=0.83) and myocardial triglyceride content (AUC=0.63).

CONCLUSION

T2DM with obesity are more prone to fatty ectopic deposits. Although the patient's myocardial function and global strain did not show be damaged, ectopic fat may cause myocardial microcirculation disturbance. At the same time, we found in addition to myocardium, excessive deposition of liver fat may also lead to myocardial microcirculation.

CLINICAL RELEVANCE/APPLICATION

Although the patient's myocardial function and global strain did not show be damaged, ectopic fat may cause myocardial microcirculation disturbance.

SSA04-07 Relationship between Myocardial Microvascular Dysfunction and Myocardial Triglyceride Content in Preserved Ejection Fraction Type 2 Diabetes Mellitus: Assessment with 1H-Magnetic Resonance Spectroscopy

Sunday, Dec. 1 11:45AM - 11:55AM Room: S102CD

Participants
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PURPOSE

Cardiac lipid over-storage and lipotoxic injury to cardiomyocytes have been considered as one of the important mechanisms of cardiac dysfunction coursed by metabolic abnormalities. For patients with early diabetic cardiomyopathy, the presence of myocardial microvascular dysfunction requires greater attention. The purpose of this study was to assess the effects of myocardial triglyceride content on left ventricle myocardial microvascular dysfunction in type 2 diabetes mellitus with Preserved left ventricle ejection fraction (LVEF).

METHOD AND MATERIALS

forty-eight type 2 diabetes patients (23 males, age 56.23±10.65) and fifteen healthy volunteers were prospectively enrolled. All of them were underwent CMR (3.0-T, Siemens Medical Solutions, Erlangen, Germany). We excluded patients with LVEF <55%. All cardiac function parameters were measured using the cine sequence. Myocardial perfusion parameters included upslope, time to maximum signal intensity (TTM) and max signal intensity (MaxSI), which were calculated by the signal-time curve of the first-pass myocardial perfusion imaging. Single-voxel 1H-magnetic resonance spectroscopy was performed to detect the myocardial triglyceride content, which was calculated as a percentage relative to the signal of myocardial water by the post-processing software (jMRUI, version 6.0).

RESULTS

Myocardial triglyceride content was significantly higher in T2DM patients compared with healthy volunteers (1.46±0.705% vs. 0.61±0.22%, p< 0.001). Systolic and diastolic function did not significantly differ between patients and healthy. The Pearson analysis showed the myocardial triglyceride content was associated with LVEDV (r=0.32, p<0.05), LVESV (r=0.31, p<0.05), upslope (r=-0.34, p<0.05) and TTM (r=0.37, p<0.05). Multivariable analysis indicated that myocardial triglyceride content was associated with TTM (ß=0.51,p<0.05, 95%CI:2.24-20.74), independently of diabetic duration, age, sex, BMI, blood pressure and LV functional parameters.

CONCLUSION

Myocardial triglyceride content is increased in preserved ejection fraction T2DM and is associated with myocardial microvascular dysfunction, independently of diabetic duration and Individual basic characteristics.

CLINICAL RELEVANCE/APPLICATION

For diabetic with preserved ejection fraction,myocardial triglyceride content is increased than normal, and is associated with myocardial microvascular dysfunction

SSA04-08 Novel Short Inversion Time 3D LGE Imaging in Ischaemic Scars

Sunday, Dec. 1 11:55AM - 12:05PM Room: S102CD

Participants
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PURPOSE

Late gadolinium enhancement (LGE) visualizes myocardial scar and fibrosis. After myocardial infarction (MI), subendocardial infarcts can be missed due to poor contrast between the blood pool and the subendocardium. The aim of this study was to evaluate the benefit of 3D LGE imaging using a single breath-hold inversion recovery sequence with a fixed, short inversion time (TI =100 ms) (short3D LGE) in comparison to standard 3D LGE imaging with an adjusted TI (3D LGE).

METHOD AND MATERIALS

3D LGE and short3D LGE (both sequences with the same spatial resolution of 1.2 x 1.2 mm² and slice-thickness of 8 mm; field of view, 350 x 350 mm², single breath-hold) were acquired in 40 patients with MI (12 female, mean age 61.1 ± 14 years) at 1.5T (Achieva, Philips, Best, Netherlands). Two independent, blinded readers evaluated 680 segments (AHA 17-segment model) using a 5-point Likert scale in terms of scar visibility. Contrast-to-noise ratio (CNR) between scar and blood pool and between normal myocardium and blood pool was calculated in both datasets.

RESULTS

3D LGE showed 131 infarcted segments out of 680 (19.2%), short3D LGE revealed 141 segments (20.7%). Short3D LGE demonstrated better scar visibility (4.3 vs 2.9, $p < 0.01$) and excellent CNR between scar and blood pool (824.3 ± 249 vs. 221 ± 156, $p < 0.01$), but weak CNR between remote myocardium and blood pool (247.5 ± 241 vs. 1246.6 ± 363, $p < 0.01$) compared to 3D LGE. Agreement between the readers was moderate for 3D LGE and substantial for short3D LGE (weighted $\kappa = 0.55$ vs. 0.76).

CONCLUSION

Short3D LGE provided very good scar visualization and revealed even more infarcted segments in comparison to standard 3D LGE. Although not suitable to replace standard 3D LGE imaging due to insufficient contrast between remote myocardium and blood pool, this novel single breath-hold sequence could be used additionally to standard 3D LGE imaging, especially in patients with subendocardial scars and suboptimal nulling of the myocardium.

CLINICAL RELEVANCE/APPLICATION

Short3D LGE with fixed inversion time makes scar detection easier especially in subtle subendocardial infarcts and when myocardial nulling is difficult.

SSA04-09 The Relationship between Circulating miR-1 Change and Ischemia-Reperfusion Injury in Patients with ST-Segment-Elevation Myocardial Infarction: A Cardiovascular Magnetic Resonance Study

Sunday, Dec. 1 12:05PM - 12:15PM Room: S102CD

Participants
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PURPOSE

This study aimed to evaluate the relationship between circulating microRNAs (miRNAs) and ischemia-reperfusion injury using cardiovascular magnetic resonance (CMR).

METHOD AND MATERIALS

Sixty patients with a first STEMI treated with primary percutaneous coronary intervention(PCI) who underwent CMR imaging at 1 week and 3-6 months after STEMI were evaluated. miR-1 was measured using PCR-based technologies in plasma samples collected at admission and 3 days after PCI. The difference of miR-1 (ΔmiR-1) was calculated. The relationship between ΔmiR-1 and Microvascular obstruction (MVO) was estimated. The association between ΔmiR-1 and the changes of LV diastolic volumes(%ΔLVEDV), and ejection fraction(%ΔLVEF) at follow up were estimated.

RESULTS

The miR-1 at admission showed no difference between MVO positive group and MVO negative group ($P > 0.05$). miR-1 at admission exhibited positive associated with %ΔLVEDV at 3-6 months ($r=0.378$, $P < 0.05$). No significant difference was found between miR-1 at admission and changes of LVEF during follow-up ($P = 0.43$). The expression different of miR-1 showed difference in the MVO positive group and MVO negative group, 5.46 ± 15.32 vs. -5.45 ± 12.37, respectively,$p<0.01$. The area under the curve of receiver operator curve analysis for ΔmiR-1 was 0.81,and when the cut off valve of ΔmiR-1 was 1.54,the sensitivity and specificity were 0.64,0.91, respectively. No significant difference was found between ΔmiR-1 at admission and %ΔLVEDV, and %ΔLVEF.

CONCLUSION

Plasma ΔmiRNA-1 was associated with ischemia-reperfusion injury in STEMI patients undergoing PCI. miRNA-1 at admission was a predictor of LV remodeling at 3-6 months after STEMI.

CLINICAL RELEVANCE/APPLICATION

Plasma ΔmiRNA-1 could potentially be applied to estimate ischemia-reperfusion injury extent in STEMI patients undergoing PCI.

SSA05

Chest (ILD/COPD/Airways)

Sunday, Dec. 1 10:45AM - 12:15PM Room: E350

CH CT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Jonathan D. Dodd, MD, Boston, MA (*Moderator*) Speaker, Boehringer Ingelheim GmbH;
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Sub-Events

SSA05-01 Pulmonary Surface Irregularity as a Quantitative CT Biomarker for Idiopathic Pulmonary Fibrosis

Sunday, Dec. 1 10:45AM - 10:55AM Room: E350

Awards
Trainee Research Prize - Fellow

Participants
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PURPOSE

Idiopathic pulmonary fibrosis (IPF) causes peripheral fibrotic changes that lead to pulmonary surface irregularity (PSI). The purpose of this study was to assess the accuracy of a quantitative PSI score on high-resolution chest CT for predicting transplant-free survival in patients with IPF.

METHOD AND MATERIALS

For this IRB-approved HIPAA-compliant retrospective single-center observational pilot study, adult patients diagnosed with IPF (N=50; 25F/25M) were age and sex matched with a control group with no known lung disease (N=50; 25F/25M). While blinded to clinical data, three readers independently measured PSI on ten high-resolution axial CT images using custom semi-automated software (Liver Nodularity LLC, Hoover, AL). Patients' age, gender, and pulmonary function test (PFT) results were used to calculate the GAP index, a method for predicting mortality in IPF. A t-test was used to compare the PSI scores between cohorts. Multivariate cox regression analysis was used to associate PSI score and GAP index with transplant-free survival in the IPF cohort. Inter-observer agreement assessed by intraclass correlation coefficient (ICC).

RESULTS

There were zero (0/100) technical failures for measuring the PSI score. Median time to measure the PSI score was 4.7 min. A mean PSI score of 5.38 for the IPF cohort was significantly higher than 3.14 for the control cohort ($p<0.001$). The median (range) PSI score in the IPF cohort was 5.21 (3.05-9.33). The PSI score was independent of the FVC, DLCO and the GAP index ($r=0.07$, $p=0.6$), ($r=-0.07$, $p=0.6$), and ($r=0.16$, $p=0.2$), respectively. The median transplant-free survival for the IPF cohort was 3.6 years. In univariate analysis, patients with IPF and a high PSI score (>median) were 5 times more likely to die than patients with IPF and a low PSI score (HR:5.03; 95%CI:1.86-13.6). In multivariate analysis, only the PSI score was associated with transplant-free survival (HR:1.36 per unit increase; 95%CI:1.01-1.84). Inter-observer agreement for the PSI score among 3 readers was good (ICC:0.75; 95%CI:0.63-0.84).

CONCLUSION

Quantitative measurement of pulmonary surface irregularity on high-resolution chest CT images has good inter-observer agreement and is a strong independent predictor of transplant-free survival in patients with IPF.

CLINICAL RELEVANCE/APPLICATION

The pulmonary surface irregularity (PSI) score is a broadly applicable, quantitative CT biomarker that has high inter-observer agreement and is predictive of survival in patients with IPF and potentially many other forms of pulmonary fibrosis.

SSA05-02 Identification of Pathological UIP in Patients with an Alternative Diagnosis (to IPF) Pattern using Quantitative CT Analysis

Sunday, Dec. 1 10:55AM - 11:05AM Room: E350

Participants
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PURPOSE

New IPF guidelines support pursuing surgical lung biopsy in patients with an alternative diagnosis pattern on chest computed tomography (CT) scans. However, up to half of these patients will still have UIP on pathology. The purpose of this study was to determine if a commercially available quantitative imaging tool could be used to identify patients with an alternative diagnosis CT pattern who were highly likely to have a UIP histologically.

METHOD AND MATERIALS

Chest CT scans and lung biopsy specimens were available for review in 225 subjects who had undergone multidisciplinary diagnosis. In 92 of these subjects, their CT pattern was suggestive of an alternative diagnosis to IPF and these patients were included in the study. Non-contrast CT scans were analyzed using the Computer Aided Lung Informatics for Pathology Evaluation and Rating (CALIPER) program, which quantifies the amount of various abnormal CT patterns on chest CT. The resulting data was analyzed statistically using the student's t-test or Mann-Whitney U test as appropriate. Multivariable analysis using logistic regression was performed.

RESULTS

The volume of low attenuation regions, reticulation, ground-glass opacity, honeycombing, or total lung volume did not predict the presence of UIP pattern on pathologic specimens. However, the total vessel related structures (VRS) volume on chest CT was significantly higher in subjects with UIP on pathology as opposed to those without UIP on pathology (182.8±18.3 cm3 versus 140.2±24.3 cm3, respectively; P<0.001). On multivariable analysis, VRS (P=0.032) and race (P=0.041) were significantly associated with UIP pathology. A VRS cut-off of 173 cm3 or greater was associated with a UIP pathology in 84.2% (32/38) of cases. VRS value less than 173 cm3 was associated with a UIP pathology in only 44.4% (24/54) of cases (P<0.001).

CONCLUSION

In subjects with an alternative diagnosis pattern on CT, a higher VRS is associated with a significantly higher proportion of UIP on pathology. At a threshold value of 173 cm3, the predictive accuracy for UIP on lung biopsy specimens approaches that reported for the probable UIP pattern on CT. Application of this to clinical practice could potentially minimize the need for performing lung biopsies for patients in whom a confident diagnosis could not be achieved.

CLINICAL RELEVANCE/APPLICATION

VRS may be an adjunct to HRCT in predicting pathology in patients with diffuse lung disease.

SSA05-03 Preliminary Result of Respiratory Change Analysis For Peripheral Normal-Appearing Lung Field By Dynamic-Ventilation CT: Comparison Between Idiopathic Pulmonary Fibrosis and Connective Tissue Disease Associated Interstitial Lung Disease

Sunday, Dec. 1 11:05AM - 11:15AM Room: E350

Participants
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PURPOSE

To compare cross-correlation coefficients (CCC) as an index of concordance of normal appearing lung fields in sub-pleural regions with those located in the center in regional density-based parameters on dynamic-ventilation CT between idiopathic pulmonary fibrosis (IPF) and interstitial lung disease of connective tissue disease (CTD-ILD)

METHOD AND MATERIALS

Five IPF and 5 CTD-ILD patients underwent dynamic-ventilation CT by using 320-row scanner (Aquilion ONE, Canon Medical

Five IPF and 5 CTD-ILD patients underwent dynamic-ventilation CT by using 320-row scanner (Aquilion ONE, Canon Medical Systems, Otawara, Tochigi, Japan) with 16cm-coverage during 5.5m-sec single respiration for upper and lower lung fields in a single examination (4.8 mSv). Spherical volumes of interests (VOI) with 10mm-diameter were set on normal appearing lung area in central and sub-pleural regions at the level of aortic arch, tracheal bifurcation and orifice of right lower pulmonary vein in both lungs at peak-inspiration. Dedicated software automatically tracked VOI based on combined algorithm including non-rigid registration techniques in the remaining phase during a single respiration. CCC between central and sub-pleural regions for mean, kurtosis and skewness of CT density histogram and estimated air volume calculated based on mean CT density in VOI were obtained. Mann-Whitney U test was performed to compare the CCCs between IPF and CTD-ILD in total as well as ventral and dorsal lung fields.

RESULTS

In total, CCCs for kurtosis in IPF were significant lower than those in CVD-ILD (IPF median: 0.636 IQR: 0.256-0.978, CTD-ILD median: 0.974, IQR: 0.934-0985, p<0.0001). Similarly, CCCs for kurtosis in IPF were significant lower both in ventral and dorsal lung fields as compared with CTD-ILD (ventral area; median for IPF: 0.58, median for CTD-ILD: 0.976, p<0.021, dorsal area; median for IPF: 0.636, median for CTD-ILD: 0.972, p<0.0003). For mean, skewness of CT density histogram and estimated air volumes were almost similar between IPF and CTD-ILD.

CONCLUSION

Dynamic-ventilation CT demonstrated lower CCC for kurtosis in IPF indicative of temporal ventilation disproportion in sub-pleural normal appearing regions.

CLINICAL RELEVANCE/APPLICATION

Dynamic-ventilation CT could be useful for detection early-stage IPF in combination with regional analysis of density-based parameters for sub-pleural normal area.

SSA05-04 Radiomic Hyper-Curvature Features for Predicting Survival of Patients with Idiopathic Pulmonary Fibrosis

Sunday, Dec. 1 11:15AM - 11:25AM Room: E350

Participants
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PURPOSE

To evaluate the comparative performance of a radiomic hyper-curvature (RHC) model of lung CT images in the prediction of the overall survival of patients with idiopathic pulmonary fibrosis (IPF).

METHOD AND MATERIALS

We retrospectively collected clinical and lung CT data of 172 IPF patients with pulmonary function tests from the Lung Tissue Research Consortium. The lung regions were extracted from the CT images using our previously developed method, after which the bronchi and aerated lungs were separated using histogram thresholding, region growing and mathematical morphology. To characterize patients' lungs, we computed 363 RHC features that characterize the principal curvatures, curvedness, light/dark blobs, lines and sheets, and curvature scales of the bronchi and the aerated lungs. An elastic-net penalty method was used to select and combine these RHC features with a Cox proportional hazards model for predicting the survival of the patient. Evaluation was performed by use of bootstrapping with 1,000 replications, where concordance index (C-index) was used as a measure of prediction performance. The performances of the RHC model was compared with the clinical biomarkers of gender and age, and gender, age, and physiology (GAP) index by use of two-sided t-test.

RESULTS

Bootstrap evaluation yielded the following C-index values: (a) age and gender: C-index 52.1%, [95% confidence interval (CI): 44.8, 59.3]; (b) GAP index: C-index 58.9%, [CI: 50.8, 67.2], P<0.0001 in comparison with (a); (c) RHC: 71.2% [CI: 65.6, 76.9], P<0.0001 in comparison with (b). Kaplan-Meier survival curves of patients stratified to low- and high-risk groups based on the RHC model showed statistically significant (P < 0.0001) difference.

CONCLUSION

The RHC model yielded higher performance than that of GAP model in the prediction of overall survival. Thus, RHC can be an effective imaging biomarker for predicting overall survival of patients with IPF.

CLINICAL RELEVANCE/APPLICATION

Radiomic hyper-curvature features that are automatically calculated from lung CT images can provide an effective prognostic imaging biomarker for precise management of patients with IPF.

SSA05-05 Diagnosis of Idiopathic Pulmonary Fibrosis (IPF) Applying the New Diagnostic Criteria of 2018 ATS/ERS/JRS/ALAT Guidelines

Sunday, Dec. 1 11:25AM - 11:35AM Room: E350

Participants
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PURPOSE

In 2018, the new diagnostic criteria has been proposed for diagnosis of idiopathic pulmonary fibrosis (IPF) from ATS/ERS/JRS/ALAT. This study was to evaluate the evolution of diagnosis of IPF by comparison of the new criteria to the previous 2011 guideline.

METHOD AND MATERIALS

This retrospective study included 535 patients with pathologically proven fibrosing interstitial pneumonia including usual interstitial pneumonia (UIP, n=339), nonspecific interstitial pneumonia (NSIP, n=97) and chronic hypersensitivity pneumonitis (HP, n=98). Three experienced chest radiologists who were blinded to the pathologic diagnosis classified the HRCT pattern of disease based on 2011 criteria (UIP, Possible UIP and Inconsistent with UIP) and 2018 criteria (UIP, Probable UIP, Indeterminate for UIP and Alternative diagnosis) for the diagnosis of UIP. Classification based on 2011 and 2018 criteria were compared and interobserver agreement was evaluated. In each classification, overall survival of patients was also evaluated.

RESULTS

Of the 535 cases, 177 (33.1%) had HRCT findings of UIP, 148 (27.7%) had probable UIP, 39 (7.3%) had indeterminate for UIP and 171 (32.0%) had alternative diagnosis. Of 184 cases with possible UIP based on 2011 criteria, 148 (80.4%) cases were categorized to probable UIP and 36 (19.6%) cases categorized to indeterminate UIP. Among those with probable UIP, 104 (70.3%) had pathologically UIP (concordant group), 33 (22.3%) had NSIP and 11 (7.4 %) had HP. 39 of those with indeterminate for UIP on HRCT had pathologically UIP in 28 cases (71.8%). Of the 339 patients with pathologically UIP, subjects with indeterminate for UIP showed significantly better survival compared to other groups based on 2018 criteria (log-rank test, P=0.001). Between 2011 and 2018 criteria, interobserver agreement did not showed significant difference (2018, $\kappa = 0.512$ for; 2011, $\kappa = 0.546$).

CONCLUSION

Applying the new diagnostic criteria for diagnosis of IPF, group of possible UIP based on 2011 criteria can be reclassified to two different categories, probable UIP and indeterminate for UIP based on 2018 criteria. The patients with indeterminate for UIP on HRCT showed better prognosis compared to the other groups based on new criteria.

CLINICAL RELEVANCE/APPLICATION

In the new CT criteria for diagnosis of IPF, group of possible UIP based on 2011 criteria can be reclassified to probable UIP and indeterminate for UIP, which seems to have different prognosis.

SSA05-06 Deep Learning Enables Automatic Classification of Emphysema Pattern on Computed Tomography

Sunday, Dec. 1 11:35AM - 11:45AM Room: E350

Participants
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Edwin K. Silverman, MD, PhD, Boston, MA (*Abstract Co-Author*) Grant, GlaxoSmithKline plc; Travel support, GlaxoSmithKline plc; Speaker, Novartis AG

PURPOSE

Visual pattern of emphysema on chest CT, using the Fleischner Society classification scale, is associated with physiologic impairment and risk of death. We sought to determine whether subject-level emphysema pattern, classified using a deep learning (DL) method, could predict impairment and mortality.

METHOD AND MATERIALS

9652 subjects in the COPDGene study, with available baseline CT and visual emphysema scores, were partitioned into two non-overlapping sets (2507 for training and 7143 for testing). A DL algorithm was trained to classify pattern of parenchymal emphysema according to Fleischner criteria. We compared visual and DL emphysema scores with clinical parameters including pulmonary function tests (PFT). The Cox proportional hazard model was used to evaluate relationships between emphysema scores and survival. For independent verification the DL algorithm was also tested using 1962 subjects enrolled in the ECLIPSE study.

RESULTS

Emphysema classification by the DL method was associated with impairment on PFTs, six-minute walk distance and St. George's Respiratory Questionnaire ($p < 0.0001$ in each case). DL emphysema classification improved fit of linear mixed models in the prediction of these clinical parameters compared to visual scoring ($p < 0.0001$). Compared to subjects without emphysema, mortality was greater in subjects classified as having emphysema grade beyond trace (adjusted hazard ratios were 1.47, 1.64, 2.94, 5.27, and 9.67, respectively, for mild, moderate, confluent and advanced destructive, $p<0.01$). Testing in the ECLIPSE cohort showed comparable results.

CONCLUSION

Pattern of emphysema, scored automatically using DL, is associated with functional impairment and risk of mortality. Compared with visual scoring, DL provides additional information that can be used to predict diminished function and mortality risk.

CLINICAL RELEVANCE/APPLICATION

Standardized, objective assessment of radiologic images using DL could facilitate subject selection for clinical trials, and risk stratification in clinical practice or in lung cancer screening.

SSA05-07 Structural Image-based Computational Model to Assess Pulmonary Ventilation in COPD Patients: A Comparison with Xenon-enhanced Dual-energy CT Imaging Data

Sunday, Dec. 1 11:45AM - 11:55AM Room: E350

Participants
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Tom Povey, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Thoracic computed tomography (CT) is an established technique routinely used to detect structural pulmonary abnormalities. The aim of this study was to demonstrate the CT-based full-scale airway network (FAN) flow model and to compare the modelled pulmonary ventilation with xenon-enhanced dual-energy computed tomography (Xe-DECT) derived pulmonary ventilation in chronic obstructive pulmonary disease (COPD) patients.

METHOD AND MATERIALS

A total of 9 COPD patients underwent Xe-DECT scanning. The virtual non-contrast (VNC) images and ventilation maps were coregistered without the influence of lung volume and evaluated using in-house software. The geometries of lobes and large airways were segmented from VNC images for the FAN flow modelling. Small airways were generated utilising the branch growing algorithm. To enhance the patient-specificity on the FAN model, pulmonary tissue density map extracted from CT images and the lung function tests were applied for the initial and boundary conditions of the model. The FAN model computed the dynamic characteristics of airway flow. In addition to the air flow, the model solved dynamic scalar transfer to simulate gas ventilation. Ventilation maps projected on a coronal plane and line profiles of ventilation were used for comparison of the FAN model and Xe-DECT images. The visual analysis with models and images was performed by experienced radiologists. Pearson correlation coefficients were calculated to assess their correlation.

RESULTS

The pulmonary ventilation calculated from the FAN model was visibly similar to the Xe-DECT images, and the Pearson correlations of the ventilation profiles on the projected plane between the model and images were statistically significant ($r = 0.83 \pm 0.13$, $P<0.001$).

CONCLUSION

The CT-based FAN model showed visual and statistical significance when correlated with the Xe-DECT imaging data. The FAN model utilising structural data may provide additional ventilation information.

CLINICAL RELEVANCE/APPLICATION

The FAN model utilising structural CT data may be used to derive pulmonary ventilation maps and quantitative ventilation data.

SSA05-09 Gender Differences in Airway Dimensions: A Study Based on Quantitative Computed Tomography

Sunday, Dec. 1 12:05PM - 12:15PM Room: E350

Participants
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PURPOSE

The fairly high prevalence of more chronic obstructive pulmonary disease (COPD) in individuals who had never smoked and the increased risk in women raise important questions about the role of gender differences in the airway dimensions. However, there are limited data on non-smokers. Therefore, we investigated how quantitative high-resolution computed tomography (HRCT) measures of wall area percentage (WA%) vary with sex of non smokers.

METHOD AND MATERIALS

We included 94 cases including 49 males and 45 females who underwent chest CT. All included subjects were non-smokers; without current or ex-chronic pulmonary disease (such as chronic obstructive pulmonary disease, asthma, bronchiectasia, lung cancer, chronic inflammation) and all underwent HRCT examination. The HRCT images were quantitatively assessed, providing airway dimensions. We compared the differences of inner diameter, wall area percentage (WA %) for each airway between males and females.

RESULTS

The median age was 64 in males and 68 in females. Internal diameter were smaller for women than men in all measured airway (3.51 ± 0.90 VS 4.23 ± 1.17 mm for segmental; and 2.64 ± 0.43 vs 2.97 ± 0.46 mm for subsegmental bronchi respectively, $p < 0.001$).

However, women had greater WA% in segmental and subsegmental bronchi (62.59±0.07 VS 56.27 ±11.42 for segmental; and 67.36±0.09 VS 57.97±0.16 for subsegmental bronchi, P<0.001.

CONCLUSION

We found significant differences in quantitative HRCT measures of WA% and internal diameter between varying sex of non smokers. Although gender and smoking are strong contributors to COPD, the differences found in this study may explain, in part, variations in disease prevalence-other factors also seem to be important.

CLINICAL RELEVANCE/APPLICATION

Quantitative high-resolution computed tomography (HRCT) measures of wall area percentage (WA%) vary with sex of non smokers.

SSA06

Science Session with Keynote: Emergency Radiology (Practice Management)

Sunday, Dec. 1 10:45AM - 12:15PM Room: N227B

ER SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Scott D. Steenburg, MD, Zionsville, IN (*Moderator*) Institutional research collaboration, IBM Corporation
Karen S. Lee, MD, Boston, MA (*Moderator*) Nothing to Disclose
Howard P. Forman, MD, New Haven, CT (*Moderator*) Nothing to Disclose

Sub-Events

SSA06-01 Emergency Radiology Keynote Speaker: Optimizing Efficiency and Quality

Sunday, Dec. 1 10:45AM - 11:05AM Room: N227B

Participants
Scott D. Steenburg, MD, Zionsville, IN (*Presenter*) Institutional research collaboration, IBM Corporation

SSA06-03 Imaging Workflow Acceleration at a Level 1 Trauma Centre after 24/7 In-house Radiologist Staff Coverage Implementation

Sunday, Dec. 1 11:05AM - 11:15AM Room: N227B

Participants
Francesco Macri, MD, PhD, Vancouver, BC (*Presenter*) Nothing to Disclose
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Faisal Khosa, Vancouver, BC (*Abstract Co-Author*) Scholarship, Canadian Association of Radiologists Scholarship, Vancouver Coastal Health
Savvas Nicolaou, MD, Vancouver, BC (*Abstract Co-Author*) Institutional research agreement, Siemens AG; Stockholder, Canada Diagnostic Centres

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PURPOSE

This study aims to evaluate the effect of 24/7 staff radiologist shifts at a Level 1 Trauma Centre on study turnaround time and final report release times as measured by relevant time frames and categorized by CTAS score, radiology shift and day of the week.

METHOD AND MATERIALS

A retrospective chart analysis was conducted on all patients over 18 years old with scans performed at the emergency department (ED). A total of 68,846 exams from pre-24/7 period were taken (Oct 1, 2012 to Sept 30, 2013) and a total of 71,255 from post-24/7 period (Oct 1, 2013 to Sept 30, 2014). The Canadian Triage and Acuity Score (CTAS) was recorded for each patient, categorizing them from most to least acute: CTAS 1 (Resuscitation), 2 (Emergent), 3 (Urgent), 4 (Less Urgent) and 5 (Non-Urgent). The time between imaging request and end of imaging (Time A) and between end of imaging and final report (Time B) were calculated. The Student's t-test and Mann-Whitney test were used to determine statistical significance between pre- and post-24/7 staff radiologist time lengths, where $p<0.05$ was considered statistically significant.

RESULTS

Time A significantly decreased between pre and post-24/7 by 87 min on average for patients with CTAS 3, 71 min for patients with CTAS 4 and 29 min for patients with CTAS 2. Time B was significantly shortened by 332 min on average for patients with CTAS 2, 316 min for patients with CTAS 1 and 3 and 259 min for patients with CTAS 4. The largest decrease in Time B was observed for patients with CTAS 2, with reductions over the shifts that were newly covered by 24/7 Radiology staff, by an average of 626.6 mins during overnight shifts and weekends.

CONCLUSION

The implementation of around-the-clock attending radiologist coverage at our Level 1 Trauma Centre significantly decreased time between image request and imaging completion for patients with CTAS 2 to 4, and between imaging completion and final report release for patients with CTAS 1 to 4. Patients with CTAS 2 benefitted from the largest decrease in time for this time frame.

CLINICAL RELEVANCE/APPLICATION

The presence of 24/7 staff radiologists can significantly reduce imaging time and report finalization times for CTAS 2 and 3 patients, respectively, which in turn may contribute to faster disposition of ED patients and therefore facilitate faster care for incoming critically ill patients.

SSA06-04 Improving ED Efficiency and Patient Safety: Impact of Overnight In-house Radiology Staff Coverage on Imaging-related ED Recalls

Sunday, Dec. 1 11:15AM - 11:25AM Room: N227B

Participants
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PURPOSE

In-house overnight staff radiologist coverage significantly reduces the overall turnaround time (TAT) for imaging studies. Although TAT is a useful metric for performance, the impact of overnight staff coverage on the quality of acute patient care is still questioned, largely due to published low discrepancy rates between radiology residents and staff. One of the more significant managemant changes related to discrepancies is the call back of patients after discharge from ED, caused by ED physicians acting on preliminary resident reports. This study analyzes how the number of ED patients being called back due to discrepant prelim and final imaging reports changed after implementing an overnight staff coverage model at a major Level 1 trauma center with over 675 acute care beds.

METHOD AND MATERIALS

Using ED visit information of two years prior (2016 and 2017) and one year after (2018) rollout of overnight radiology staff coverage, all patients were identified who had overnight imaging performed during their ED visit and who returned to the ED within 48 hours. Visit notes were assessed by two independent scores who determined if the patient's return was due to an imaging report related recall or not. Descrepant scorers' opinions were assessed by a senior third scorer performing chart review. Logistic regression was used to determine if the new coverage model had a significant impact on the number of ED recalls related to imaging report discrepancies.

RESULTS

ED patient visits with overnight imaging were 9,412 in 2016; 9,736 in 2017; and 10,254 in 2018. Number of imaging related recalls were 51, 57 and 7 (in 2016, 2017, and 2018 respectively). Coverage model was a statistically significant predictor of recalls ($b = 2.11$, $z = 5.42$, $p < 0.001$), before the new overnight staff coverage patients were 8.30 95%CI[4.16, 19.68] times more likely to get a recall related to discrepancy in prelim and final read. Despite an increase of ED visits with overnight imaging of almost 9% in 3 years, imaging related absolute number of recalls dropped by 90%.

CONCLUSION

Despite increasing ED visits, overnight attending coverage has significantly reduced ED recalls related to imaging, improving ED patient safety and ED efficiency.

CLINICAL RELEVANCE/APPLICATION

Overnight final imaging interpretation by in-house staff radiology coverage significantly reduces callback rate in ED patients requiring acute care, improving ED efficiency and patient safety.

SSA06-05 Imaging Information Overload: Quantifying the Burden of Interpretive and Non-Interpretive Tasks for CT Angiography for Aortic Pathologies in the ED

Sunday, Dec. 1 11:25AM - 11:35AM Room: N227B

Participants
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PURPOSE

Advances in CT imaging has allowed for improved resolution and the ability to create high quality reformations. The unintended consequences is an increase in the volume of images that theradiologist must interpret. With improved imaging, more incidental findings are found, leading to recommendations for follow-up imaging. CT angiography of the chest (CTA) is the study of choice to evaluate aortic pathologies, but over-utilization in the emergency department (ED) can increase the cognitive burden on the radiologist. The purpose is to quantify the complexity of CTA chest exams performed in the ED over a 10 year period.

METHOD AND MATERIALS

This is a retrospective analysis of adults patients (>= 18 years) presenting to the ED at a single Level 1 tertiary care hospital for

the evaluation of acute aortic pathology with CTA Chest from Jan 1, 2005 to Dec 31, 2015. The number of images and reformats per study were obtained from PACS. Aortic findings, including aortic dissection, aneurysm, and post-operative aortic repair, were determined from the radiology report. Imaging recommendations and verbal communication were evaluated. Descriptive statistics and partial correlation analysis were performed with correlation coefficients (CC) calculated.

RESULTS

A total of 4368 studies were performed over 10 years. The mean age was 64 years, with 56.8% male patients. Studies per year increased 163% over the study period. The number of images and reformats per scan increased from 487 to 2918 images and 6.4 to 13.7 reformats (CC = 0.93 and 0.96, respectively, both $p<0.0001$). The proportions of exams requiring verbal communication increased from 9.3% to 24.7% (CC=0.77, p=0.008) and recommendations from 1.8% to 28.9% (CC=0.66, p=0.03). Overall proportion of cases with aortic findings was 27.3%. However, the proportion of exams with aortic findings did not significantly change over the study period (CC= 0.12, p=0.73).

CONCLUSION

This study demonstrates the increasing complexity of CTA exams as seen by the increase in the number of images and reformats per study. Non-interpretive tasks also increased accordingly. Although the number of CTA exams increased over time, the proportion of studies with aortic pathology remained constant.

CLINICAL RELEVANCE/APPLICATION

More compliant adherence to appropriateness criteria and careful thought in determining necessary reformats in CTA protocols should be considered in order to prevent radiologist burn out.

SSA06-06 Value of a 24-hour Teleradiology Service for Cruise Ships in Detecting Previously Missed Pathologies

Sunday, Dec. 1 11:35AM - 11:45AM Room: N227B

Participants
Frank Oliver G. Henes, MD, Hamburg, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

The introduction of a round the clock teleradiology service for a cruise ship as a novel concept in maritime telemedicine. Using a VPN tunnel we implemented a workflow with a routine high standard interpretation of x-rays that were imaged on board and read by experienced radiologists in a tertiary hospital.

METHOD AND MATERIALS

This study was conducted between February 2017 and September 2018 and four cruise ships were involved in total. The ships were equipped with a mobile digital x-ray unit using digital storage imaging plates (SIEMENS Polymobil). The digital x-ray images were transmitted in a standardized fashion from the cruise ships to the hospital via satellite internet. Using VPN secured data transfer of images was managed together with patient data and integrated to the PACS (GE Healthcare, Centricity Universal Viewer). In the tertiary hospital images were analyzed by the radiologist on-call and reports were immediately sent back via VPN.

RESULTS

Overall 410 x-rays of 355 patients were acquired on board and successfully transmitted via satellite from the cruise ships to the tertiary hospital. The vast majority were skeletal x-rays (n=349) with fracture after a trauma being the most frequent query (n=259). The remaining cases were chest x-rays (n=52) with pneumonia (n=36) being the most frequent query and abdominal x-rays (n=9). In 246 cases no pathologies were seen. Common pathologies were as follows: fracture or dislocation (n=77), osteoligamental injury (n=11), arthrosis (n=16) and others (n=49). In 86% of cases the initial report by the physician on board matched the report in the tertiary hospital. However, in 14% of the cases the radiologist in the tertiary hospital detected pathologies, which were previously missed by the physician on board.

CONCLUSION

Using a VPN tunnel we were able to demonstrate a robust and well-functioning workflow allowing a routine high standard interpretation of x-rays that were imaged on board by experienced radiologists in a tertiary hospital. The radiologists in the tertiary hospital detected pathologies in 14% of the cases, which were previously overlooked and potentially would not have been treated.

CLINICAL RELEVANCE/APPLICATION

A 24-hour teleradiology service for cruise ships has the potential to improve immediate patient care in emergencies on board of cruise ships by making use of the expertise of a radiologist.

SSA06-07 Urgency Emergency Radiology: Imaging at Urgent Care Centers

Sunday, Dec. 1 11:45AM - 11:55AM Room: N227B

Participants
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PURPOSE

Urgent care centers are facilities that provide ambulatory care outside of the emergency department. The incorporation of radiography capabilities within these practices make imaging accessible and can serve as screening tests for various conditions. The purpose of this study is to examine the image utilization patterns and to quantify positive cases. In addition, the frequency of radiologist recommendations and documented verbal communication will be examined.

METHOD AND MATERIALS

This retrospective study evaluated radiographs performed for both pediatric and adult patients visiting one of 10 urgent care centers within a large metropolitan city from January 1, 2019 to March 31, 2019. All imaging was interpreted by emergency radiologists at an academic Level 1 trauma center. The number of exams were evaluated by body systems. The number of positive findings, radiologist recommendations, and documented verbal communication were quantified.

RESULTS

A total of 3289 patients were identified over the 3 month period. The average age was 38.4 years (range between 1 to 103) with 61% of patients female. Chest radiographs were the most commonly ordered study accounting for 37.4% of all exams with a positive findings rate of 16.3%. Lower extremity exams comprised of 30.0% of exams with a positivity rate of 27.6%. Upper extremity radiographs accounted for 23.6% of exams with a positivity rate of 33.0%. Imaging of the spine and ribs accounted for 7.2% of exams with 16.4% cases being positive. Abdominal and facial bone radiographs were not commonly ordered, accounting for 0.8% and 1% of all exams respectively, with 7.4% and 27.3% of cases having positive findings. Accounting for all studies, the positivity rate was 23.7%, in which 5.4% had radiologists making recommendations for further imaging or follow-up. Only 1.4% of exams required verbal communication of findings.

CONCLUSION

This study demonstrates the utilization of onsite radiography at a network of urgent care centers within a large metropolitan city, with studies interpreted by emergency radiologists at an academic teaching hospital. Chest and extremity radiographs were commonly ordered exams. Almost a quarter of studies had positive findings, although the rate of recommendations and verbal communication was low.

CLINICAL RELEVANCE/APPLICATION

This study provides insight into the workflow of incorporating ambulatory care imaging within the context of an ED radiology practice.

SSA06-08 Does Intravenous Contrast Utilization Affect CT Scan Operation in Emergency Department? A Large Urban Tertiary Academic Center Experience

Sunday, Dec. 1 11:55AM - 12:05PM Room: N227B

Participants
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PURPOSE

Rapid turnaround times in computed tomography (CT) department is essential for efficient management of high patient volumes in a busy urban emergency department. There have been a number of published studies showing prolonged emergency department (ED) stays secondary to use of oral contrast media in CT. However, there is a paucity of quantitative data on the effect of intravenous contrast media on CT workflow in ED. We analyzed the potential effect of intravenous contrast administration in CT studies on the ED workflow.

METHOD AND MATERIALS

In this retrospective study, database of CT acquisitions from April 2018 to April 2019 were retrospectively reviewed at a tertiary-level academic hospital. The non-contrast and contrast enhanced CT studies ordered by emergency department were extracted and compared. CT studies ordered for evaluation of stroke, high-energy trauma and aortic emergencies were excluded. Time intervals between order time and start of the scans were compared. For statistical analysis Mann- Whitney- U test was used. Significance was set at 0.05.

RESULTS

18951 CT scans were evaluated (13872 non-contrast CT vs 5079 contrast enhanced CT). The overall average time intervals for non-contrast CT and contrast enhanced CT were 48 minutes 38 seconds and 1 hour 17 minutes 10 seconds, respectively ($p<0.001$). Similar pattern was observed regardless of the type of CT study performed.

CONCLUSION

The use of intravenous iodinated contrast media can cause about a half-hour delay in emergency department workflow at a large

academic institution.

CLINICAL RELEVANCE/APPLICATION

At large institutions, the use of iodinated intravenous contrast media may prolong order to image acquisition time significantly. Physicians and radiologists must take the time interval difference into consideration when planning for improved operational efficiency and CT turnaround time reductions.

SSA06-09 Increasing Timely Access to Emergency CTs via Discrete Event Simulation

Sunday, Dec. 1 12:05PM - 12:15PM Room: N227B

Participants
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Ferco H. Berger, MD, Toronto, ON (*Presenter*) Speaker, Siemens AG

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PURPOSE

This study aims to investigate ways of reducing turnaround times (TAT) for urgent computed tomography (CT) studies completed at the emergency department (ED) of a major urban Academic Level 1 Trauma Center.

METHOD AND MATERIALS

To model the complex dynamics of the workflow for urgent ED patient CTs, a discrete event simulation model (DES) was developed using the software Simul8 version 24.0. The model was built using a year worth of historical data, and the base model results were validated against current performance metrics. The model was then used to explore the effects of several scenarios on emergency CT TAT, including: 1) decreasing the need for protocols assigned by radiologists, 2) increasing the number of CT technologists as well as reallocating some of their existing shifts, 3) reducing appointment booking delays, and 4) increasing overall demand for emergency CTs.

RESULTS

Scenario results were as follows: 1) reducing the number of protocols will have mild impacts on TAT (e.g. reducing the number of protocols by 30% will reduce TAT by 6.3%). 2) Reallocating one of the technologists shifts from day-time to night-time can reduce TAT by as much as 12.8%, and adding new shifts so that two CT technologists are available at all times can produce a TAT reduction of 18%. 3) Reducing booking delays by 50% will reduce TAT by 15.2%, and investing in an automated booking system for emergency cases would reduce it by 25.9%. Finally, 4) increasing demand by 5% next year and 10% the following year, will produce an increase in TAT by 3% and 11%, respectively.

CONCLUSION

This study highlights the benefits of predictive modeling the uncertainties and the dynamic behavior of complex systems such as the imaging workflow for ED patients. DES is a powerful tool that can be used to test different scenarios before committing any resources to implement process changes. The use of DES has provided insightful information of what process changes will have the most impact on TAT, and so it allows hospital leadership to focus on implementing the changes that will provide the best return.

CLINICAL RELEVANCE/APPLICATION

Modeling ED imaging workflow helps to improve operational efficiency because it provides the quantitative evidence necessary to guide decisions that aim to maximize resource investments.

SSA07

Gastrointestinal (LIRADS)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S103AB

GI MR OI

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
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Alexa G. Ortiz Escobar I, MD, Mexico City, Mexico (*Moderator*) Nothing to Disclose

Sub-Events

SSA07-01 Accuracy of Liver Imaging Reporting and Data System Category 4 or 5 for Diagnosing Hepatocellular Carcinoma: A Systematic Review and Meta-Analysis

Sunday, Dec. 1 10:45AM - 10:55AM Room: S103AB

Participants
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PURPOSE

We aimed to systematically determine the accuracy of Liver Imaging Reporting and Data System (LI-RADS) for magnetic resonance imaging (MRI) diagnosis of hepatocellular carcinoma (HCC) and to determine the sources of heterogeneity between reported results.

METHOD AND MATERIALS

Original studies that reported the diagnostic accuracy of LI-RADS for HCC using MRI were identified in MEDLINE and EMBASE up to October 25, 2018. Study quality was assessed using QUADAS-2. We categorized studies into two groups, LR-5, and LR-4 or LR-5, criteria, and obtained the meta-analytic summary sensitivity and specificity of both criteria with a bivariate random-effects model. Subgroup analyses and meta-regression analysis were performed to further explore study heterogeneity.

RESULTS

Among the 157 articles screened, 18 studies covered LR-5 (3651 lesions), and 16 studies covered LR-4 or LR-5 (3182 lesions). For the LR-5 criterion, the meta-analytic summary sensitivity and specificity were 62.1% (95% CI [confidence interval], 53.9-69.7%; $I2$=91.6%) and 92.8% (95% CI, 89.9-94.9%; $I2$=66.8%), respectively (Fig. 1A). For the LR-4 or LR-5 criterion, the meta-analytic summary sensitivity and specificity were 88.4% (95% CI, 82.7-92.5%; $I2$=89.2%) and 81.7% (95% CI, 73.5-87.8%; $I2$=88.3%), respectively (Fig. 1B). For the LR-5 criterion, the three factors of subject enrollment, MRI scanner field strength, and type of reference standard were significantly associated with study heterogeneity (P <= 0.04). For the LR-4 or LR-5 category criterion, the three factors of subject enrollment, MRI contrast agent, and type of reference standard were significantly associated with study heterogeneity (P <= 0.03).

CONCLUSION

The LR-5 criterion was highly specific, but showed suboptimal sensitivity for diagnosing HCC in patients at risk of HCC. In comparison with the LR-5 criterion, the sensitivity of the LR-4 or LR-5 criterion increased, but the specificity decreased. Substantial study heterogeneity was noted, and four significant factors were identified: subject enrollment, the type of reference standard, MRI scanner field strength, and contrast agent type.

CLINICAL RELEVANCE/APPLICATION

The LR-5 criterion was highly specific, but had suboptimal sensitivity for diagnosing HCC. Substantial study heterogeneity was noted, and further randomized controlled studies are needed to validate the diagnostic performance of LI-RADS.

SSA07-02 Using Ancillary Features to Update Liver Imaging Reporting and Data System version 2018 on Gadobenate Dimeglumine-Enhanced MRI

Sunday, Dec. 1 10:55AM - 11:05AM Room: S103AB

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PURPOSE

To evaluate whether ancillary features on gadobenate dimeglumine-enhanced MRI can be used to upgrade LI-RADS categories from LR-4 to LR-5.

METHOD AND MATERIALS

260 patients with chronic liver disease at high risk for HCC were retrospectively included. Hepatobiliary phase (HBP) was obtained 2 hours after gadobenate dimeglumine injection at 3.0T scanner, and all HBP images can be used to evaluate liver observations according to LI-RADS criteria. Blinded to the clinical and pathological data, two abdominal radiologists evaluated LI-RADS v2018 major and ancillary features for the largest observation in each patient on MR images in consensus. Observations were categorized according to LI-RADS version 2018 as well as various modifications to LI-RADS, in which LR-4 could be upgraded to LR-5 by the presence of ancillary features as listed in Table 1. Diagnostic sensitivity, specificity, accuracy, false negative rate (FNR), false positive rate (FPR), positive predictive value (PPV), negative predictive value (NPV) of category LR- 5 were calculated for LI-RADS v2018 and for each modified LI-RADS. Receiver operating characteristic (ROC) curves were generated and areas under the ROC curve (AUC) were computed.

RESULTS

Final diagnoses for the 260 observations included 216 HCCs, 5 intrahepatic cholangiocarcinomas, 5 combined hepatocellular-cholangiocarcinomas, 2 metastatic tumors, 2 focal nodular hyperplasias, 7 arterio-portal shunts, 20 hemangiomas, 1 abscess, 1 cyst, and 1 dysplastic nodule. Overall, 0% LR-1(0/2) and LR-2 (0/28), 90% (10/11) LR-3, 86% LR-4 (19/22), and 99% LR-5 (174/175) were HCCs according to LI-RADS v2018. The final LI-RADS categories, as well as the sensitivity, specificity, accuracy, FNR, FPR, PPV, NPV and AUC of LR-5 using v2018 and each modified LI-RADS are listed in table 1. Modified LI-RADS I (in which HBP hypointensity can be used to upgrade LR-4 to LR-5) showed higher sensitivity (94.4 vs 80.6%) and accuracy (93.5 vs 83.5%) than LI-RADS v2018 without significantly reducing specificity (88.6 vs 97.7%), PPV (97.6 vs 99.4%), or AUC (0.915 vs 0.891).

CONCLUSION

Modified LI-RADS I may improve sensitivity and accuracy for diagnosing HCC without impairing specificity or positive predictive value.

CLINICAL RELEVANCE/APPLICATION

HBP hypointensity may be used to upgrade LR-4 to LR-5 without impairing specificity or positive predictive value for a diagnosis of HCC on gadobenate dimeglumine-enhanced MRI in Chinese patients.

SSA07-03 Effect of Upgrading LR-4 Lesions to LR-5 Using HCC Favoring Ancillary Features on Diagnostic Performance of HCC

Sunday, Dec. 1 11:05AM - 11:15AM Room: S103AB

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PURPOSE

To determine whether upgrading LR-4 lesion to LR-5 using ancillary features (AF) favoring HCC in LI-RADS version 2018 increases the diagnostic performance of HCC.

METHOD AND MATERIALS

112 patients with chronic B-, C- viral hepatitis or cirrhosis and surgically proven primary hepatic malignancy (98 HCC, 11 cHCC-CCC, 2 IHCC, 1 dysplastic nodule) were evaluated with gadoxetate-enhanced MRI in 2013. Two board-certified radiologists retrospectively assessed the presence of major features of HCC, imaging features of LR-M criteria, and HCC favoring ancillary features according to LI-RADS v2018 and assigned an LI-RADS category for each nodule in consensus. The diagnostic accuracy of

each LI-RADS category was described by sensitivity, specificity and positive and negative predictive values with 95% confidence interval. LR-4 lesions were then upgraded to LR-5 if (1) at least one HCC favoring AF was present and (2) lesion was not previously upgrade from LR-3 to LR-4. Diagnostic accuracy of this upgraded LR-5 was compared to initial LR-5 using McNemar X2-test. 5-year overall survival (OS) was evaluated via Kaplan-Meier method, log rank test and Cox proportional hazard model.

RESULTS

All three out of three LR-3 lesions, 18 (85%) out of 21 LR-4 lesions, 70 (98%) out of 71 LR-5 lesions and 7 (41%) out of 17 LR-M lesions were HCCs. As for non-HCC malignancy, except for 3 (27%) out of 11 cHCC-CCCs and 1 dysplastic nodule, all non-HCC malignancy were assigned as LR-M. 9 (42%) out of 21 initial LR-4 lesions were upgraded to LR-5 due to more than one HCC favoring AF. For HCC, initial LR-5 showed sensitivity and specificity of 71.4% and 92.8%, while HCC favoring AF-upgraded LR-5 showed sensitivity and specificity of 79.6% and 85.7%. Accuracy of upgraded LR-5 was 80.4% compared to 74.1% of initial LR-5. In McNemar X2-test, specificity of initial LR-5 was not significantly different from specificity of upgraded LR5 (P=0.317).

CONCLUSION

Upgrading LR-4 lesions to LR-5 increases accuracy without significantly decreasing HCC specificity; thus HCC favoring AF can be used to upgrade LR-4 to LR-5.

CLINICAL RELEVANCE/APPLICATION

Contrary to LI-RADS v2018, HCC favoring ancillary features should be used to upgrade LR-4 lesions to LR-5 because it increases accuracy of HCC without significantly decreasing HCC specificity.

SSA07-04 Assessing Accuracy of the LI-RADS v2017 Treatment Response Algorithm in Evaluating Ablated Hepatocellular Carcinoma

Sunday, Dec. 1 11:15AM - 11:25AM Room: S103AB

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PURPOSE

To assess the performance of the LI-RADS v2017 Treatment Response Algorithm (TRA) in identifying viability of ablated hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

This was an Institutional Review Board approved and HIPAA compliant retrospective study. Patients who underwent ablation of HCC prior to liver transplantation between January 1, 2011, and December 31, 2015, at a single tertiary care center were identified. All patients underwent pretreatment abdominal MRI within 90 days of treatment and post-treatment MRI within 90 days of transplant. Based on transplant histopathology colocalized with imaging, lesions were categorized as completely (100%) or incompletely (<=99%) necrotic. Three radiologists classified each nodule into an LR-TR category (Viable/Non-Viable) according to imaging features. Final LR-TR categories were compared with histopathology and the correlation was calculated. Inter-reader agreement was assessed using Fleiss' Kappa.

RESULTS

36 patients with 53 lesions were included. 58% (31/53) of lesions were ablated using microwave ablation, and the remaining 42% (22/53) with radiofrequency ablation. TRA accuracy for predicting complete tumor necrosis at the time of transplant ranged from 0.75-0.78, with a negative predictive value ranging from 0.77-0.80. Accuracy for predicting incomplete tumor necrosis at the time of transplant ranged from 0.61-0.78, with a positive predictive value ranging from 0.68-0.89. 11% (6/53) of treated lesions were LR-TR Equivocal by consensus, with most (5/6) incompletely necrotic on histopathology. Inter-reader agreement for pre-treatment LI-RADS category was k=0.44 (95% CI 0.16-0.62), lower than agreement for TRA category, k=0.68 (95% CI 0.57-0.78).

CONCLUSION

The TRA is accurate in predicting viable or non-viable HCC after ablation. Of the ablated lesions rated as LR-TR Equivocal, many were incompletely necrotic nodules.

CLINICAL RELEVANCE/APPLICATION

The LI-RADS TRA's performance for predicting histopathological necrosis in HCC lesions following locoregional therapy has not been extensively assessed, and in this work is shown to be accurate.

SSA07-05 Ancillary Features in LI-RADS Version 2018: A Strategy to Improve Diagnostic Performance for HCC on Gadoxetate Disodium-enhanced MRI

Sunday, Dec. 1 11:25AM - 11:35AM Room: S103AB

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PURPOSE

To determine the frequency of occurrence and strength of association with hepatocellular carcinoma (HCC) of each ancillary feature (AF) in the Liver Imaging Reporting and Data System (LI-RADS) version 2018, and to develop an appropriate strategy for applying the AFs to improve diagnostic performance on gadoxetate disodium-enhanced MRI.

METHOD AND MATERIALS

A total of 385 nodules (283 HCCs, 18 non-HCC malignancies, 84 benign nodules) of 3.0 cm or smaller in 266 patients at risk for HCC who underwent gadoxetate disodium-enhanced MRI in 2016 were retrospectively evaluated. Two radiologists independently assigned a LI-RADS category to each nodule. The frequency and diagnostic odds ratio of each AF were assessed. To improve the diagnostic performance for HCC, various criteria were developed based on the number of AFs detected favoring malignancy in general or HCC in particular. Generalized estimating equation models were used to compare the diagnostic performance of each criterion with that of the major features (MFs) only.

RESULTS

The AFs showing a significantly different frequency between HCC and non-HCC lesions were restricted diffusion, mild-moderate T2 hyperintensity, transitional-phase hypointensity, hepatobiliary-phase hypointensity, and hepatobiliary-phase isointensity. Of these AFs, hepatobiliary-phase hypointensity had the highest frequency and strongest association with HCC. When we applied AFs in addition to MFs, the new criterion (with a number of AFs >=4) had significantly higher sensitivity (80.6% vs. 70.0%; *P*<.001) than MFs only, without a significant lowering of specificity (85.3% vs. 90.2%; *P*=.060).

CONCLUSION

The AFs varied in the frequencies of occurrence and strengths of association with HCC. To improve the diagnostic performance for HCC, a new criterion of four or more AFs in addition to the MFs might be the best option.

CLINICAL RELEVANCE/APPLICATION

A criterion of four or more AFs in addition to MFs may be the best strategy to improve the diagnostic performance for HCC on gadoxetate disodium-enhanced MRI using LI-RADS, and is recommended in the evaluation of suspected HCC in patients at risk.

SSA07-06 LI-RADS v2018: Value of Quantitative Assessment of Arterial Phase Hyperenhancement and Washout with Extracellular MRI Contrast Agent

Sunday, Dec. 1 11:35AM - 11:45AM Room: S103AB

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PURPOSE

To assess the influence of quantitative arterial phase hyperenhancement (APHE) and washout (WO) of contrast enhanced MRI on LI-RADS v2018 categorization and compare the quantitative LI-RADS score with conventional qualitative reading.

METHOD AND MATERIALS

60 patients (19 female; mean age 56y) at risk for HCC with 71 liver lesions (28 hepatocellular carcinoma (HCC), 43 benign lesions) who underwent MRI with extracellular contrast agent were included in this HIPPA-compliant retrospective study. Four blinded radiologists independently reviewed all MRI and assigned a LI-RADS score per lesion. Two other radiologists drew regions of interests within the lesion and the adjacent liver parenchyma on pre- and post-contrast MR images. The percentage of arterial enhancement and the liver-to-lesion contrast ratio were calculated for quantification of APHE and WO. The presence or absence of APHE, WO or both was recorded according to the quantitative measurements. Using these quantitative parameters, a quantitative LI-RADS score was assigned in lesions classified as LR-3-5. The diagnostic accuracy was assessed with receiver-operating-characteristics (ROC) analysis and the DeLong test to compare for significant differences between the area under the curve (AUC).

RESULTS

The ROC analysis for the qualitative LI-RADS score showed an AUC of 0.869, 0.946, 0.940 and 0.919 for reader 1, 2, 3, and 4, respectively. The quantitative LI-RADS score where only APHE/WO/or both were replaced showed an AUC of 0.875/0.849/0.874, 0.942/0.924/0.914, 0.933/0.917/0.878 and 0.902/0.852/0.843 for readers 1, 2, 3 and 4, respectively. The AUC of the quantitative LI-RADS score was significantly lower than of the qualitative score only for reader 4 when quantitative WO (p=0.012) and both, quantitative APHE and WO (p=0.047) were used.

CONCLUSION

The qualitative LI-RADS score showed similar or higher diagnostic accuracy compared to the quantitative LI-RADS score. Therefore, qualitative visual assessment appears to be the better approach to scoring liver lesions according to LI-RADS v2018.

CLINICAL RELEVANCE/APPLICATION

A quantitative approach for LI-RADS scoring does not increase diagnostic accuracy; hence, visual assessment should be maintained to score liver lesions according to LI-RADS v2018.

SSA07-07 Hepatocellular Carcinoma Detection by Abbreviated-Protocol Dynamic Contrast-enhanced MRI in Patients with Cirrhosis Using LI-RADS v2018

Sunday, Dec. 1 11:45AM - 11:55AM Room: S103AB

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PURPOSE

Determine the accuracy of abbreviated-protocol dynamic contrast enhanced MRI and complete-protocol MRI for detection of hepatocellular carcinoma (HCC) in cirrhosis patients

METHOD AND MATERIALS

In this IRB-approved HIPAA-compliant retrospective cohort study, 100 consecutive cirrhosis patients underwent standard complete-protocol MRI (cMRI) at 1.5T or 3T for workup for suspected HCC, using extracellular gadolinium contrast. Images of abbreviated-protocol MRI (aMRI; coronal T2-weighted and axial dynamic contrast-enhanced T1-weighted sequences) were extracted from cMRI (aMRI sequences + unenhanced axial T2-, T1-, and diffusion-weighted sequences). Both aMRI and cMRI images were independently read by 4 blinded fellowship-trained abdominal radiologists using Liver Imaging and Reporting Data System (LI-RADS) v2018. Each review (aMRI, cMRI) was scored as positive if any liver observation of LR-4, 5, or M was present, or negative otherwise. Each patient was followed from the time of index cMRI until final HCC status was determined using a composite reference standard of histopathlogy <=6 months, consensus expert panel review of index cMRI or followup-CT/MRI <=6 months (by two different senior abdominal radiologists), and clinic followup at >12 months (in those with negative index cMRI only). Patient-level HCC detection sensitivity and specificity were calculated for aMRI and cMRI with 95% confidence intervals, and compared by McNemar's test at a=0.05.

RESULTS

Mean age of the study cohort was 57.7 years (range 23-77). 14 patients were excluded due to non-diagnostic exam (5), prior HCC treatment (1), use of hepatobiliary contrast agent (1), loss to followup (3), and unable to determine final HCC diagnosis (4). Per-reader detection accuracy of aMRI and cMRI in remaining 86 cirrhosis patients are shown in Figure. No statistically significant differences were found by McNemar's test (p>0.05) between aMRI and cMRI, in sensitivity or specificity.

CONCLUSION

Abbreviated-protocol dynamic contrast enhanced MRI has sensitivity 89.3-96.4% and specificity 84.5-89.7% for HCC detection; no statistically significant difference was found compared to complete-protocol MRI. Further validation is needed in an asymptomatic cirrhosis population to support its use as a screening test.

CLINICAL RELEVANCE/APPLICATION

Abbreviated-protocol dynamic contrast enhanced MRI (a 15-min exam) offers high sensitivity and specificity for hepatocellular carcinoma (HCC) detection and has a potential as a screening test in cirrhosis patients at risk for HCC.

SSA07-08 Inter-reader Reproducibility and Overall Survival Predictability of LI-RADS Tumor Response Algorithm after Drug-eluting-Beads Transarterial Chemoembolization as an Initial Treatment Hepatocellular Carcinoma

Sunday, Dec. 1 11:55AM - 12:05PM Room: S103AB

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PURPOSE

LI-RADS (Liver Imaging and Reporting Data System) Tumor Response (LR-TR) algorithm standardizes the assessment of tumor

response to locoregional therapy in hepatocellular carcinoma (HCC). This study evaluated the inter-reader reproducibility of LR-TR categories (nonviable, equivocal, viable), and whether LR-TR categories predict survival in patients with HCC after first-time drug-eluting-beads transarterial chemoembolization (DEB-TACE).

METHOD AND MATERIALS

All DEB-TACE procedures from 2011 to 2015 at two hospitals affiliated with a liver transplant center were reviewed. Key exclusion criteria were prior HCC-related treatment and lack of pre- and post-treatment multiphasic abdominal MRI or CT within 3 months of DEB-TACE. Four readers (2 radiology residents and 2 fellowship-trained abdominal radiologists) independently reviewed the pre-and post-treatment exams, assigned LR-TR categories to up to two treated tumors per patient, and measured the size of the pre-treatment and the enhancing component of the treated tumor. Inter-reader agreement for LR-TR categories and tumor size were respectively assessed by Fleiss' kappa and intra-class correlation coefficient (ICC). Kaplan-Meier/Cox survival analysis for patient-level LR-TR category (the mode of all lesion LR-TR categories by all readers in a patient) was performed, before and after adjusting for Barcelona Clinic for Liver Cancer stage (BCLC A vs. >=B) and Child-Pugh-Turcott class (CPT A vs. >=B).

RESULTS

75 patients were included, yielding 108 lesions. Inter-reader agreement was moderate for the three LR-TR categories (κ=0.56 [0.55,0.58]). Inter-reader reproducibility for tumor size was excellent for untreated tumors (ICC=0.94 [0.92,0.95]) and good for treated tumors (ICC=0.83 [0.78,0.87]). No significant difference was detected in overall survival between LR-TR nonviable and viable groups (Fig. 1) before or after adjustment for BCLC stage/CPT class, respectively p=0.96 and 0.78.

CONCLUSION

LI-RADS tumor response algorithm for HCC after first-time DEB-TACE has moderate inter-reader reproducibility but may not predict overall survival. Further reader education/training is needed to improve reproducibility. Further research is needed to better translate LR-TR assessment to predict patient survival/guide therapy.

CLINICAL RELEVANCE/APPLICATION

LI-RADS tumor response algorithm for HCC requires reader education and may not predict survival in patients undergoing first-time DEB-TACE.

SSA07-09 Clinical Validation of CEUS LI-RADS in Prospective Multi-Center Study: Preliminary Results

Sunday, Dec. 1 12:05PM - 12:15PM Room: S103AB

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PURPOSE

The American College of Radiology Contrast-Enhanced Ultrasound Liver Imaging Reporting and Data System (CEUS LI-RADS) is developed to classify focal liver observations in patients at risk of HCC. The aim of this prospective multicenter study is to validate the CEUS LI-RADS.

METHOD AND MATERIALS

A total of 273 nodules from 255 patients at risk of HCC are included in this ongoing study conducted at 8 centers (6 in the USA, 1 in Canada and 1 in Italy). Focal liver observations are classified as LR-5, (definitely HCC) if greater than 1 cm with arterial phase hyperenhancement, and late, mild washout. Rim enhancement and/or early washout and/or marked washout qualify as LR-M (malignant, but not specific for HCC). Other observations are classified as definitely benign (LR-1); probably benign (LR-2), intermediate malignancy probability (LR-3); probably HCC (LR-4). Tumor-in-Vein is characterized as LR-TIV. Definite HCC diagnosis on MRI, imaging follow-up or histology for MRI-indeterminate observations were used as reference standard.

RESULTS

The median focal liver observation size is 2.4cm. Of 273 nodules, 162 (59%) have confirmed diagnosis while 111 (41%) nodules remain indeterminate, currently undergoing imaging surveillance or awaiting histological confirmation. Of 162 confirmed nodules, 136 are HCC (82%), 6 (4%) other malignancies (2 ICC, 1 combined hepatocellular-cholangiocarcinoma, 3 metastasis) and 22 (14%) are benign. A total of 84 confirmed observations are characterized as LR-5 and 100% of them are HCC. The sensitivity of LR-5 for HCC is 63%. All 14 LR-1 and LR-2 observations are benign. All 11 LR-M observations are malignant (5 HCC, 4 metastasis, 2 ICC). 67% (14/21) of LR-3 observations and 92% (24/26) of LR-4 observations are HCC. 5% of nodules are not characterized on CEUS (LR-NC)

CONCLUSION

The CEUS LR-5 classification is 100% specific for HCC, confirming high clinical value of CEUS for noninvasive HCC diagnosis.

CLINICAL RELEVANCE/APPLICATION

Contrast-enhanced ultrasound is a reliable method of focal liver observations classification in patients at risk for HCC

Printed on: 10/29/20

SSA08

Gastrointestinal (Radiomics)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S104A

AI CT GI MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

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Sub-Events

SSA08-01 MRI Radiomics Features Predict Immuno-oncological Characteristics and Recurrence of Hepatocellular Carcinoma

Sunday, Dec. 1 10:45AM - 10:55AM Room: S104A

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PURPOSE

To assess the value of qualitative and quantitative radiomics features measured with MRI for noninvasive prediction of histopathologic and genomics characteristics, as well as outcomes of hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

This retrospective study was IRB-approved and the requirement of informed consent was waived. Forty-eight patients with HCC (M/F 35/13, mean age 60y) who underwent hepatic resection or transplant within 4 months of abdominal MRI were included. Qualitative imaging traits, quantitative non-texture related and texture features were assessed in index lesions on contrast-enhanced T1-weighted and diffusion-weighted images. Advanced histopathological analysis was performed using multiplex immunohistochemistry. Gene expression analysis was performed on paraffin-embedded tissue blocks of the index HCC lesions. The association of imaging features with histopathologic and genomics features was assessed using binary logistic regression and correlation analyses. Binary logistic regression analysis was also employed to analyze the association of radiomics, histopathologic and genomics features with radiological recurrence of HCC at 12 months.

RESULTS

Qualitative (correlation coefficient r=-0.41-0.40, P<0.042) and quantitative (r=-0.52-0.45, P<0.049) radiomics features correlated with immunohistochemical cell type markers for T-cells (CD3), macrophages (CD68), and endothelial cells (CD31). MRI radiomics features also correlated with expression of immunotherapy targets PD-L1 at protein level (r=0.41-0.47, P<0.029) as well as PD1 and CTLA4 at mRNA expression level (r=-0.48-0.47, P<0.037). Follow-up imaging data up to at least 1 year after surgery was available for 43 patients, of whom 10 patients showed HCC recurrence within 1 year after surgery. Several radiomics features showed significant association with HCC recurrence (highest AUC =0.80, odds ratio=5.51, P<0.028), while histopathologic and genomics features did not (P>0.098).

CONCLUSION

We observed significant associations of MRI radiomics features with HCC histopathological and genomics characteristics and recurrence. We are currently validating these results in a prospective study.

CLINICAL RELEVANCE/APPLICATION

Our results suggest that MRI radiomics features may serve as noninvasive predictors of HCC biological properties and recurrence, providing potentially valuable information for treatment planning.

SSA08-02 Multi-Institutional Study using Radiomics and Machine Learning Model to Differentiate Benign and Malignant Focal Hepatic Lesions on Dual-Energy CT

Sunday, Dec. 1 10:55AM - 11:05AM Room: S104A

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PURPOSE

To assess the application of a machine learning (ML) model-based approach for differentiating benign and malignant focal hepatic lesions on post-contrast dual energy CT (DECT) using tumor analysis and radiomics prototypes (eXamine, Siemens Healthineers).

METHOD AND MATERIALS

Our included 174 adults from the US (Site-A: 103, 65 ± 15 years, 53M:50F) and India (Site-B=71, 48 ± 17 years, 46M:25F) with benign (Site-A=60;Site-B=35) or malignant (Site-A=43;SiteB=36) focal hepatic lesions on post-contrast dual source, DECT (Site-A: Siemens Force or Flash; Site-B: Siemens Flash). Most malignant lesions had histology; benign lesions had characteristic imaging features or were stable on follow-up CT. Low and high kV images in arterial phase (2-3mm) were de-identified, exported, and processed with the TA prototype to derive iodine concentrations and uptakes as well as 585 radiomic features within each lesion's volume and rim. ML model based statistical evaluation (Site-A: Training; Site-B: Test) was performed with the radiomics prototype. Random Forest Classifier was used to calculate the accuracy (AUC) for differentiating benign and malignant hepatic lesions.

RESULTS

Multivariate logistic regression demonstrated that 31 radiomic features enabled distinction between benign and malignant lesions (AUC 0.7-0.8; p=0.0002-0.03; gldm, glszm, glrlm, glszm, first order-kurtosis). With ML model based random forest classifier 12 inner rim radiomic features enabled lesion characterization (AUC=0.82, p<0.0001) with high specificity (97%) and positive predictive value (94%). Only 1/35 benign (flash-filling hemangioma) lesions was classified as malignant lesion (false positive). Compared to radiomics, accuracy was lower for normalized and total iodine uptake (AUC= 0.7; p-0.003; outer lesion rim).

CONCLUSION

With a ML model, the DECT based tumor analysis and radiomics prototypes enable accurate differentiation of benign and malignant hepatic lesions.

CLINICAL RELEVANCE/APPLICATION

Trained ML based predictive models can be generated and integrated with clinical workflow to characterize and classify focal hepatic lesions seen on dual-energy CT.

SSA08-03 Application of Radiomic MRI Features in Differentiation of Combined Hepatocellular Cholangiocarcinoma, Cholangiocarcinoma, and Hepatocellular Carcinoma Using Machine Learning

Sunday, Dec. 1 11:05AM - 11:15AM Room: S104A

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PURPOSE

Definitive morphological imaging features of combined hepatocellular-cholangiocarcinoma (cHCC-CC) have not been established. We aim to use radiomic features to predict diagnosis of cHCC-CC, cholangiocarcinoma (CC) and hepatocellular carcinoma (HCC) with machine learning.

METHOD AND MATERIALS

We conducted a retrospective review of pre-treatment gadolinium or gadoxetate disodium enhanced liver MRI performed between

2004 and 2018 in our institute for 86 patients with pathology proven cHCC-CC (n=38), CC (n=24) and HCC (n=24). Precontrast, arterial, portal venous, hepatic venous and 5 minutes delayed phases were included. Regions of interest (ROIs) were drawn around the largest diameter of the tumors, avoiding nearby normal tissues. 1370 radiomic features were extracted by standard library (PyRadiomics 2.1.2). Using Principle Component Analysis, they were fused to 20 first principle components that explain the majority of variance. These components were used in a 4-fold cross-validation by a Support Vector Machine (SVM) classifier to evaluate the performance of the predictive model for each MRI sequence using pathology diagnosis as endpoints.

RESULTS

We tested two endpoints predictions: 1. cHCC-CC vs. non cHCC-CC with the expectation of differentiating cHCC-CC from HCC and CC, given its unique pathology; 2. HCC vs. non HCC, due to the difference in management. For differentiation of cHCC-CC from HCC and CC, fused radiomic features from hepatic venous and precontrast phases demonstrated higher prediction value than other sequences, with AUC of 0.77 and 0.64 respectively. For the differentiation of HCC from cHCC-CC and CC, arterial, 5 min delayed, portal venous, and hepatic venous phases demonstrated highest prediction values, with AUC of 0.81, 0.80, 0.79, and 0.79 respectively.

CONCLUSION

cHCC-CC is a unique histological entity with treatment implications including liver transplantation due to poorer prognosis than either HCC or CC. Our results demonstrated fused MRI radiomic features in hepatic venous and precontrast phases are promising in differentiating cHCC-CC from HCC and CC. MRI of arterial and 5 min delayed phases have good predictive value to differentiate cHCC-CC and CC from HCC.

CLINICAL RELEVANCE/APPLICATION

The promising predicative value of radiomic MRI features in the differentiation of cHCC-CC, HCC and CC will help with improved preoperative imaging diagnosis and treatment planning including liver transplantation.

SSA08-04 A Radiomics Model Based on Preoperative Gadoxetic Acid-Enhanced MR Imaging for Predicting Liver Failure after Major Hepatectomy

Sunday, Dec. 1 11:15AM - 11:25AM Room: S104A

Participants
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PURPOSE

The clinical indexes are not sufficiently accurate in predicting the outcome of remnant liver function after surgery. The purpose of this study was to determine a radiomics model based on preoperative gadoxetic acid-enhanced MR imaging for predicting liver failure (LF) after major hepatectomy in cirrhotic patients with hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

For this retrospective study, a radiomics-based model was developed based on 101 patients with HCC, with major liver resection between June 2012 and June 2018. Radiomic features were obtained from hepatobiliary phase of gadoxetic acid-enhanced MR images. The radiomics signature was built by using the least absolute shrinkage and selection operator method and multivariable logistic regression model was adopted to establish a radiomics nomogram. Nomogram performance for predicting liver failure was determined using its receiver operating characteristics curve, calibration curve and decision curve.

RESULTS

The radiomics signature, with radiomics score calculated consisting of 5 radiomics features, achieved favorable performance for predicting LF. The radiomics nomogram, which incorporated the radiomics signature and indocyanine green clearance rate at 15 minutes (ICG-R15), showed the highest performance for predicting liver failure (area under the curve [AUC],0.894; 95% confidence intervals [CI], 0.823-0.964). The integrated discrimination improvement (IDI) analysis showed a significant improvement in the accuracy of LF prediction, especially when radiomics signature was added to the clinical prediction model (IDI = 0.117, P = 0.002).

CONCLUSION

A radiomics-based model of preoperative gadoxetic acid-enhanced MR images can be used for liver failure in cirrhotic patients with HCC after major liver resection.

CLINICAL RELEVANCE/APPLICATION

A radiomics-based model in predicting liver failure after major hepatectomy

SSA08-05 Radiomic Analysis for Preoperative T-Staging in Patients with Rectal Cancer

Sunday, Dec. 1 11:25AM - 11:35AM Room: S104A

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PURPOSE

The accurate preoperative assessment of tumor stage is critical for treatment and prognosis of rectal cancer. This study was aimed at constructing a radiomic prediction model to preoperatively assess the primary tumor (T) stage accurately in patients with rectal cancer.

METHOD AND MATERIALS

The magnetic resonance imaging (MRI) data of 349 patients with rectal cancer were collected from February 2011 to October 2017 in this study (T1, n=49; T2, n=79; T3, n=157; T4, n=64). The patients were divided randomly into training cohort (n=240) and validation cohort (n=109). The radiomic features were extracted from high-resolution T2-weighted imaging (HR-T2WI) and diffusion-weighted imaging (DWI) data, then selected to compose radiomic signatures. Incorporating the radiomic signatures and clinical independent risk factors, we constructed a radiomic assessment model by artificial neural network (ANN). The calibration, discrimination, and clinical utility of the radiomic models were assessed by independent validation.

RESULTS

The radiomic signature was significantly related to T stage of rectal cancer ($p<0.01$), and showed good preoperatively T-staging performance. The area under the curve (AUC) was 0.822, 0.733 and 0.779 in discriminating between early stages (T1 and T2 stage, T1/2) and advanced stages (T3 and T4 stage, T3/4), between T1 and T2 stages, and between T3 and T4 stages, respectively. Moreover, with combination of the raidomic signature and clinical independent risk factors, the raidiomic assessment models showed improved performance. The AUC was 0.858, 0.801 and 0.815 discriminating between T1/2 and T3/4 stages, between T1 and T2 stages, and between T3 and T4 stages, respectively. And the performance was confirmed in an independent validation cohort (AUC, 0.842, 0.773 and 0.730).

CONCLUSION

The radiomic model has an excellent performance in preoperative assessment of T stage of rectal cancer. It can improve the accuracy of T staging in patients with rectal cancer.

CLINICAL RELEVANCE/APPLICATION

The radiomic prediction model can improve the accuracy of T-staging assessment in patients with rectal cancer.

SSA08-06 Radiomics Signature on Multiparametric MRI: Association with Disease-free Survival in Patients with Locally Advanced Rectal Cancer

Sunday, Dec. 1 11:35AM - 11:45AM Room: S104A

Participants
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PURPOSE

To develop a radiomics signature based on pre-treatment multiparameter MRI features to estimate disease-free survival (DFS) in patients with locally advanced rectal cancer (LARC) after receiving neoadjuvant chemoradiotherapy (CRT) and to establish a radiomics nomogram incorporating the radiomics signature and clinicopathological findings.

METHOD AND MATERIALS

142 consecutive patients with LARC (training: validation cohorts = 71:71) were enrolled in our retrospective study. 1188 imaging features were extracted from pre-CRT T2WI, contrast enhanced T1WI, and ADC images for each patient. Least absolute shrinkage and selection operator (LASSO) Cox regression was performed to select key features and build a radiomics signature in the training set, and the cutoff point of the radiomics signature to divide the patients into high- and low-risk groups was determined using ROC curve analysis. Kaplan-Meier analysis was used to determine the association of the radiomics signature and DFS. Combining clinicopathological factors, a radiomics nomogram was constructed to validate the radiomic signatures for individualized DFS estimation. Nomogram discrimination and calibration were evaluated.

RESULTS

Higher Rad-scores were significantly associated with worse DFS in both the training and validation cohorts (both $P< 0.05$). The radiomics nomogram, incorporating the radiomics signature and ypN, tumor differentiation, and MRF, estimated DFS (C-index, 0.715; 95% confidence interval [CI], 0.67-0.79) better than the clinicopathological or Rad-score-only nomograms.

CONCLUSION

This study demonstrated that the radiomics signature is an independent biomarker for the estimation of DFS in patients with LARC. Combining the radiomics nomogram improved individualized DFS estimation.

CLINICAL RELEVANCE/APPLICATION

radiomics signature is an independent biomarker for the estimation of DFS in patients with LARC

SSA08-07 Reproducibility of Radiomics Features Using Single-Energy Dual-Source CT: Influence of Radiation Dose and CT Reconstruction Settings Within the Same Patient

Sunday, Dec. 1 11:45AM - 11:55AM Room: S104A

Participants

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PURPOSE

To investigate the impact of radiation dose and reconstruction CT settings on the reproducibility of radiomic features within the same patient, as well as to identify correction factors for mitigating these sources of variability.

METHOD AND MATERIALS

This is a retrospective study of 78 patients (33 women [mean age, 61 years; age range, 28-74 years] and 55 men [mean age, 60 years; age range, 34-81 years] with 151 metastatic liver lesions who underwent a single-energy dual-source contrast-enhanced dose split staging CT. By using the imaging raw datasets technique parameters were altered, resulting in 28 different CT datasets per patient which included different dose level, section thickness, kernel and reconstruction algorithms settings. Using a training dataset, reproducible intensity, shape and texture RFs (r2>0.95) were selected and correction factors were calculated by using a linear model to convert each RF to its estimated value under the reference technique. Using a test dataset, reproducibility of hierarchical clustering based on RFs measured under different CT techniques was assessed.

RESULTS

The percentage of RFs deemed reproducible for any variation of the different technical parameters was 11% (12/106). RFs in the shape category were the least likely to be affected by variability due to changes in technical parameters (87.5% [14/16]). Of all technical parameters, reconstructed section thickness had the largest impact on the reproducibility of RFs (12.3% [13/106]). The results of the hierarchical cluster analysis, showed improved clustering reproducibility when reproducible RFs without and with dedicated correction factors (Prob=0.62-1.0) where used.

CONCLUSION

Our patient study confirmed that many RFs are highly affected by CT acquisition and reconstruction settings to the point of being non-reproducible. By selecting reproducible RFs along with dedicated correction factors a significant improvement in the clustering reproducibility of RFs could be achieved.

CLINICAL RELEVANCE/APPLICATION

Radiomic features of databases with heterogenous CT radiation dose and reconstruction settings are largely non-reproduceable and thus, may be limited in their use for prognostic clinical studies.

SSA08-08 Prediction and Measurement of Treatment Response in Metastatic Liver Disease with Machine Learning Radiomics

Sunday, Dec. 1 11:55AM - 12:05PM Room: S104A

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PURPOSE

To assess if machine learning (ML) based-radiomics can predict and measure treatment response in patients with metastatic liver disease in patients with breast cancer.

METHOD AND MATERIALS

Our IRB approved study included 98 adult women (mean age 54±11 years) with metastatic liver disease from breast cancer. All patients underwent contrast abdomen-pelvis CT in portal venous phase at two timepoints - baseline (BL: pre-treatment) and follow-up (FU: between 3-12 months following treatment). Patients were subcategorized into three subgroups based on RECIST 1.1. criteria (Response Evaluation Criteria in Solid Tumors version 1.1): 32 with stable disease (SD), 32 with partial response (PR) and 34 with progressive disease (PD) on follow up CT. CT images from BL and FU were deidentified and exported to radiomics prototype (eXamine, Siemens Healthineers). The prototype enabled semiautomatic segmentation of the target liver lesions for extraction of first and high order radiomics. Statistical analyses with logistic regression and random forest classifiers was performed with the prototype to assess how well BL radiomics predicts treatment response, and whether radiomics can differentiate SD from

PD and PR on the two timepoints.

RESULTS

BL radiomics differentiated SD from PR (AUC 0.718) and also SD from PD (AUC 0.797). There was no significant difference between the radiomics on BL and FU CT images of patients with SD (P= 0.998). Busyness (an NGTDM feature) and surface volume ratio (a shape feature) were the most powerful predictors of PD between the BL and FU exams (AUC 0.892). BL and FU radiomics were strong measures of PR (AUC 0.938; p= 0.026 with multivariate logistic regression) and random forest classification (AUC 0.78).

CONCLUSION

Radiomics can predict and measure treatment response in patients with metastatic liver disease.

CLINICAL RELEVANCE/APPLICATION

Machine-learning based radiomics has promise to help predict and differentiate stable metastatic liver disease from progressive disease and partial response to treatment.

SSA08-09 Preoperative Prediction of Early Recurrence in Advanced Gastric Cancer: A Radiomic Model Using Computed Tomography

Sunday, Dec. 1 12:05PM - 12:15PM Room: S104A

Participants
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PURPOSE

In the clinical management of advanced gastric cancer (AGC), preoperative identification of early recurrence after curative resection is essential. Thus, we aimed to create a Radiomic Model Using Computed Tomography to predict early recurrence in AGC patients preoperatively.

METHOD AND MATERIALS

Ethical approval was obtained for this retrospective analysis, and the informed consent requirement was waived. This study enrolled 521 consecutive patients (302 in the training set and 219 in the test set) with clinicopathologically confirmed AGC from our center. Radiomic features were extracted from preoperative diagnostic CT images. Machine learning methods were applied to shrink feature size and build a predictive radiomic signature. We incorporated the radiomic signature and clinical risk factors into a nomogram using multivariable logistic regression analysis. The area under the curve (AUC) of operating characteristics (ROC) and accuracy were assessed to evaluate the nomogram's performance in discriminating early recurrence.

RESULTS

A radiomic signature, including two hand crafted features and one deep learning feature, was significantly associated with early recurrence (p-value<0.0001 for both sets). The radiomic signature showed a good performance for discriminating early recurrence with AUCs of 0.820 (95% CI, 0.772-0.869) in the training set and 0.799 (95% CI, 0.741-0.857) in the test set. In addition, clinical N stage, clinical T stage, and carcinoembryonic antigen levels were considered independent predictors for early recurrence. The nomogram, combining all these predictors, showed powerful prognostic ability in both the training and test sets with AUCs of 0.851 (95% CI, 0.807-0.895) and 0.842 (95% CI, 0.791-0.894), respectively. The predicted risk yielded good agreement with the observed recurrence probability.

CONCLUSION

By incorporating a radiomic signature and clinical risk factors, we created a radiomic nomogram to predict early recurrence in patients with AGC, preoperatively, which may serve as a potential tool to guide personalized treatment.

CLINICAL RELEVANCE/APPLICATION

radiomic nomogram may improve risk stratification and serve as a potential biomarker for guiding individual care in patients with AGC.

SSA09

Gastrointestinal (Rectal Cancer)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S103CD

GI MR OI

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

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Sub-Events

SSA09-02 Radiomic Shape Descriptors of Rectal Wall and Lumen on MRI are Associated with Low and High Pathologic Tumor Stages After Chemoradiation for Rectal Cancer

Sunday, Dec. 1 10:55AM - 11:05AM Room: S103CD

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PURPOSE

The relatively poor expert restaging accuracy of MRI in rectal cancer after chemoradiation (sensitivity ~53%) may be due to difficulties in visual assessment of residual tumor. However, both the rectal wall and lumen may distort in shape due to tumor impact. While previous studies have examined radiomic appearance (texture) of rectal tumors on MRI, we evaluated whether radiomic shape features of the entire rectal wall and the lumen are associated with pathologic tumor stage after chemoradiation therapy (CRT).

METHOD AND MATERIALS

60 patients were retrospectively identified across 2 sites, from whom an axial 3T T2W MRI was available after standard-of-care chemoradiation but prior to excision surgery. The entire rectal wall (ERW) and the lumen were annotated by an expert radiologist on all MRIs. 96 shape descriptors (2D and 3D) were extracted from each of lumen and ERW separately, for each patient. Top 2 ranked radiomic shape features associated with pathologic tumor stage (evaluated on excised specimens) were identified via cross-validation on a training subset from Site 1 (n=33). These were evaluated using discriminant analysis on a hold-out validation set of 27 patients (n=13 from Site 1, n=14 from Site 2).

RESULTS

Top-ranked radiomic shape descriptors for distinguishing low (ypT0-2) and high (ypT3-4) stages after CRT were 2D shape change in ERW across rectal volume (p=0.0004) and 3D volumetric roundness of the lumen (p=0.0014). These features resulted in an AUC of 0.82 in the training set (n=33), and an AUC of 0.82 on hold-out validation (n=27, 2 sites). By contrast, ERW volume (p=0.0357) and lumen volume (p=0.8431) were not significantly different or discriminatory between pathologic stages in either cohort.

CONCLUSION

Radiomic shape features of the entire rectal wall and lumen are highly relevant for discriminating patients with low and high tumor stage after chemoradiation, likely capturing implicit effects of residual tumor expanding or contracting the rectum.

CLINICAL RELEVANCE/APPLICATION

First study of radiomic shape features of rectal structures on post-chemoradiation MRI reveal physiologically intuitive differences in low and high pathologic tumor stages, and could enable better evaluation of rectal cancer response to neoadjuvant CRT.

SSA09-03 Diagnostic Accuracy of Magnetic Resonance Tumor Regression Grade for Pathological Complete Response in Rectal Cancer Treated with Neoadjuvant Chemoradiotherapy: A Systematic Review and Meta-Analysis

Sunday, Dec. 1 11:05AM - 11:15AM Room: S103CD

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PURPOSE

We aimed to systematically evaluate and determine the diagnostic accuracy of the magnetic resonance tumor regression grade (mrTRG) for diagnosing pathological complete response (pCR) and pathological T1 or lower than T1 stage (<=ypT1) in rectal cancer patients treated with neoadjuvant chemoradiotherapy (CRT), with a focus on the selection of candidates for less aggressive treatments such as local excision or watch and wait approaches.

METHOD AND MATERIALS

Original studies that investigated the correlation of mrTRG with pathological tumor regression grade and pathological T stage were identified in MEDLINE and EMBASE up until August 31, 2018 according to PRISMA guidelines. The search terms included colorectal cancer, chemoradiation therapy, magnetic resonance imaging, and response or regression. A bivariate random effects model was used to for statistical analysis.

RESULTS

Six studies with 916 patients were included. The meta-analytic summary sensitivity and specificity of mrTRG 1 for pCR were 32.3% (95% CI, 18.2-50.6%) and 93.5% (95% CI, 91.5-95.1%) (Fig. 1A), while for <=ypT1 they were 31.8% (95% CI, 16.2-53.0%) and 94.7% (95% CI, 91.9-96.5%) (Fig.1B). On the contrary, sensitivity and specificity of mrTRG 1 or 2 for pCR were 69.9% (95% CI, 60.2-78.1%) and 62.2% (95% CI, 56.2-67.8%), while those for <=ypT1 were 71.4% (95% CI, 61.6-79.6%) and 67.7% (95% CI, 59.8-74.7%).

CONCLUSION

mrTRG 1 showed high specificity for pCR and <=ypT1, but suboptimal sensitivity. mrTRG 1 or 2 showed higher sensitivity for pCR and <=ypT1, but lower specificity. Because of the suboptimal sensitivity of mrTRG 1, it might be limited as a criterion for organ preservation after CRT.

CLINICAL RELEVANCE/APPLICATION

Good response of mrTRGs may be a limited criterion for diagnosing pCR or selecting patients for local excision or watch and wait approaches.

SSA09-04 Locally Advanced Rectal Cancer: The Value of Intravoxel Incoherent Motion Imaging and Diffusion Kurtosis Imaging in Evaluating Pathological Complete Response to Neoadjuvant Chemoradiotherapy

Sunday, Dec. 1 11:15AM - 11:25AM Room: S103CD

Participants
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PURPOSE

To investigate the role of intravoxel incoherent motion diffusion-weighted imaging (IVIM) and diffusion kurtosis imaging (DKI) in evaluating pathological complete response (pCR) to neoadjuvant chemoradiotherapy (CRT) in locally advanced rectal cancer (LARC).

METHOD AND MATERIALS

42 LARC patients (cT3/4 or N+) were consecutively enrolled in this prospective study, and underwent pre- and post-CRT rectal MRI on a 3.0 T MRI scanner, including IVIM and DKI sequences with 12 b values. They all received neoadjuvant CRT and subsequent surgery. Pathological tumor regression grade (TRG) of the surgical specimen served as the reference standard. Patients were divided into pCR (TRG0) and non-pCR group (TRG1-3). Slow diffusion coefficient (D) (.10-3 mm2/s), fast diffusion coefficient (D*) (.10-3 mm2/s), perfusion-related diffusion fraction (f), mean kurtosis (MK), mean diffusion (MD) (.10-3 mm2/s) and monoexponential ADC value (.10-3 mm2/s) were calculated by manually drawing ROIs on three representative slices of primary and residual tumor on pre- and post-CRT b=800 s/mm2 images. ROIs were then copied to images of IVIM and DKI parameters. Independent t test, Mann-Whitney U test, and ROC curves were used for statistical analyses.

RESULTS

The pCR group (n=7) had a significant higher post-CRT f (P=0.012), D*(P=0.027), MD (P=0.005) and ADC value (P=0.016) than non-pCR group (n=35). Also the percentage changes of f (P=0.034), MD (P=0.043) and ADC value (P=0.030) after CRT were significant higher in the pCR group. ROC curves showed that post-CRT f, D*, MD and ADC value presented AUCs of 0.739, 0.722, 0.788, and 0.767 in selecting pCR, and the post-CRT MD had a higher sensitivity (82.9% vs. 77.1%) and similar specificity (both 85.7%) than ADC value. Besides, percentage changes of f, MD, and ADC value after treatment presented AUCs of 0.755, 0.747, and 0.735 in identifying pCR, and the percentage f had a higher specificity (85.7% vs. 71.4%) and lower sensitivity(71.4% vs. 80%) than ADC value.

CONCLUSION

IVIM and DKI parameters, especially MD and f could help to differentiate pCR from non-pCR after nCRT in LARC.

CLINICAL RELEVANCE/APPLICATION

IVIM and DKI could help to more reliably select pCR in patients with LARC after CRT, thus could help individualized treatment in clinical. Complere responders may receive non-operative treatment instead of radical resection with reduced surgery related morbidities and improved life quality.

SSA09-05 The Additional Value of Post-nCRT MRI Characteristics for Predicting Locally Advanced Rectal Cancer Patients 3-year DFS

Sunday, Dec. 1 11:25AM - 11:35AM Room: S103CD

Participants
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PURPOSE

The aim of this study was to investigate the additional value of post-nCRT MRI characteristics for predicting locally advanced rectal cancer patients 3-year DFS.

METHOD AND MATERIALS

In this retrospective study, pre- and post-neoadjuvant chemoradiotherapy (nCRT) MRI morphologic (e.g. pre-nCRT MRI-detected extramural venous invasion) and clinicopathologic variabilities (e.g. pathological complete response) were evaluated in all patients. 3-year DFS was estimated using Kaplan-Meier product-limit method, and Cox proportional hazards models were used to determine associations between morphologic or clinicopathologic variabilities and survival outcomes.

RESULTS

A total of 171 patients (median age of 55 years; age range, 27-82 years) were included in the study. 137 (80.1%) patients performed both pre- and post-nCRT MRI examination, while 34 (19.9%) patients did not perform post-nCRT MRI. Pathological type of tumor was an independent predictor for 3-year survival on pathologic variables. In univariate and multivariate analysis, non-adenocarcinoma was a significant factor for worse long-term survival outcomes with the DFS of 38.0 months (95% CI 25.1-51.0 months, P=0.022) in univariate and with the HR of 3.155 (95% CI 1.160-8.586) in multivariate analysis (P=0.024). Other pathologic characteristics subgroup (vascular tumor thrombus, dentate line involvement, CRM involvement and KRAS gene mutation) showed worse DFS compared to reference subgroup in Kaplan-Meier univariate analysis, but the difference were not significant in COX analysis.The 3-year DFS of patients with positive mrEMVI were 52.6 months in univariate analysis, while the negative patients were 65.1 months (P=0.003). Multivariate analysis result was not significantly different (P=0.563), but the HR in mrEMVI positivity patients was 1.270 .In univariate analysis, mrTRG was the independent predictor for 3-year survival on post-nCRT MRI variables (P=0.011) . Partial response patients showed worse DFS compared to those with complete response (HR=2.809, 95% CI 0.451-17.496), but the difference was not significant (P=0.268).

CONCLUSION

Pathological type was the independent risk factor for long-term outcomes in LARC patients; while the other morphologic and clinicopathologic characteristics were not significantly related to survival.

CLINICAL RELEVANCE/APPLICATION

Pre- and post-nCRT MRI characteristics provide more individualieze predicting information for LARC patients outcomes.

SSA09-06 MRI in Restaging Locally Advanced Rectal Cancer: Detailed Reasons of Discrepancy when Taking Pathology as Standard of Reference

Sunday, Dec. 1 11:35AM - 11:45AM Room: S103CD

Participants
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PURPOSE

To analyze the detailed reasons of discrepancy between restaging MRI and pathology in comprehensive morphologic indicators of tumor response

METHOD AND MATERIALS

The MRI and pathological data of 57 consecutive patients who received neoadjuvant treatment and curative surgery from August 2015 to July 2018 were prospectively collected and retrospectively analyzed. The sensitivity and specificity of restaging MRI in detecting tumor regression grade (TRG), T, N stage, circumferential resection margin (CRM), extramural vascular invasion (EMVI) were calculated when taking pathology as reference. One-by-one comparison between restaging MRI and pathology was conducted to analyze the detailed reasons of discrepancy.

RESULTS

The sensitivity of restaging MRI in detecting TRG3-5, T3-4, N+, CRM involvement and EMVI was 77.1%, 100.0%, 75.0%, 87.5% and 91.7%, respectively. Whereas the specificity was 72.7%, 62.5%, 70.7%, 85.7% and 64.4%, respectively. Perirectal irregular spiculation of fibrosis caused overstaging of T2 disease. Extramural infiltration depth of residual tumor in fibrotic area was not accurately identified, therefore accurate T3 staging was not obtained. Massive fibrosis mixed with tumor-like signal could stretch mesorectal fasica or adjacent organs, and be evaluated as persistent CRM involvement or T4b disease. Fibrosis could manifest as similar shape and signal intensity to invaded vessels shrinked after treatment, resulted in the overstaging of EMVI. Inflammatory cell infiltration in fibrotic area could demonstrate as high signal intensity on DWI, which was similar to residual tumor and resulted in the omission of pCR. Acellular mucin scattered in massive fibrosis could manifest as residual tumor. Edematous mucosa and submucosa, and muscularis propria could also be mistaken as residual tumor for the intermediate signal intensity on T2 weighted images.

CONCLUSION

MRI was prone to overstage the residual tumor. The discrepancy between MRI and pathology was mostly caused by the misinterpretation of fibrosis. Inflammation cell infiltration, acellular mucin, edematous mucosa and submucosa, and muscularis propria could also be mistaken as residual tumor.

CLINICAL RELEVANCE/APPLICATION

Preoperative prediction of tumor response is essential for treatment decision. Identification of what MRI features lead to misinterpretation could help improve selection of good responders.

SSA09-07 CT-derived Radiogenomic Signatures Predicting BRAF/KRAS Mutations and Overall Survival in Primary Colorectal Carcinoma Patients

Sunday, Dec. 1 11:45AM - 11:55AM Room: S103CD

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PURPOSE

To determine the ability of CT-derived radiogenomic signatures/models to predict between key mutation (BRAF/KRAS/other wild-type {WT}) of primary colorectal carcinoma (CRC) patients and their overall survival (OS).

METHOD AND MATERIALS

In this retrospective study, we evaluated 134 histopathological proven CRC patients with known genomic data, and available treatment naïve contrast-enhanced CT scans. Using 3D slicer, the entire primary tumor was semi-automatically segmented on the porto-venous phase, and the volume of interest (VOI) was extracted; subsequently, the VOI was imported into our in-house pipeline radiomic analysis to obtain 610 radiomic features per volume. For feature selection, classification model and validation, the least absolute shrinkage selection operator regression (LASSO), Xgboost, and leave-one-out-cross-validation were used, respectively.

RESULTS

Of 134 patients (male, 66; female, 68; average age, 57.9 years) with BRAF (N=47), KRAS (N=46), and WT (N=41); for mutation status, top 55 LASSO features were able to stratify the CRC patients, with an accuracy (99.3%), area under the curve (99.88%-100%), and *P*-value (2.2e-16). For overall survival 40 LASSO features were able to predict good versus poor OS (30 months), with sensitivity, specificity, and *P*-value of 100%, 97%, and 2e-16 respectively. Additional subgroup analysis revealed the ability of only 10 LASSO features to predict OS for BRAF, KRAS and WT with *P*-value of 3.049e-9, 9.19e-11, and 2.87e-7.

CONCLUSION

Our radiogenomic signatures were able robustly to stratify the CRC patients based on their molecular data, and to predict their OS status using pre-treatment CT scans.

CLINICAL RELEVANCE/APPLICATION

Radiogenomics is an emerging field that lends a non-invasive tool for quick CRC patients stratification based on their genomic/molecular profiles.

SSA09-08 Building of Comprehensive Prognostic Scoring System for Recurrence After Rectal Cancer Surgery: Based on Radiologic and Clinicopathologic Evaluation

Sunday, Dec. 1 11:55AM - 12:05PM Room: S103CD

Participants
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PURPOSE

To evaluate risk factors of rectal cancer and develop prognostic scoring system for individual recurrence risk assessment.

METHOD AND MATERIALS

Total 489 rectal cancer patients who underwent surgery from 2009 to 2013 were included in the study. Univariate and multivariate Cox proportional hazard model were used to determinate significant prognostic factors among clinical (age, sex, clinical stage, CEA level, anastomotic leak), radiological (anal verge, tumor length, peritoneal reflection, T-, N-stage, lateral LN involvement, threatened circumferential resection margin (CRM), T3 subclassification, extramural venous invasion (EMVI), mean apparent diffusion coefficient (ADC), diffusion volumetry), and pathologic variables (pCRM, lymphatic/venous/perineural invasion, pathologic subtype, immunohistochemistry markers, T-, N-stage). Individual prognostic scores were calculated from selected significant prognostic factors. Patients were divided into low, moderate, and high risk groups according to the prognostic scores. Recurrence rates of each risk groups were obtained. Recurrence free survivals were analyzed by Kaplan-Meier method with the log-rank test.

RESULTS

Distance from anal verge, presence of EMVI on MRI; perineural invasion, N stage on pathology were selected as significant prognostic factors in multivariate analysis. Pathologic T-stage was added to these factors to build prognostic scoring system. Risk coefficient of each 5 factor was assigned as 2, 3, 3, 3, 1, respectively, according to the beta coefficient (ß = 0.52, 0.65, 0.8, 0.31, 0.89). Total 489 patients were classified as low (score 0-1, n=172), intermediate (score 2-3, n=123), and high (score 4-11, n=194) risk groups, according to individual prognostic scores (0-11). Recurrence rates of low, intermediate, and high risk groups were 7.6%, 15.5%, 36.6%, respectively ($p<0.001$). The Kaplan-Meier curve for recurrence free survival showed the prognostic differences between the 3 risk groups.

CONCLUSION

Multifactorial prognostic scoring system based on radiologic and clinicopathologic variables correlated well with recurrence rate after rectal cancer surgery and could be a comprehensive approach to evaluate the prognosis of individuals.

CLINICAL RELEVANCE/APPLICATION

New prognostic scoring system, based on radiologic, and clinicopathologic factors, is useful for comprehensive assessment of individual recurrence risk in the post-operative rectal cancer patients.

SSA09-09 Scan Time Reduction in Rectal Diffusion-Weighted Imaging: Evaluation of the Simultaneous Multislice Acceleration Technique

Sunday, Dec. 1 12:05PM - 12:15PM Room: S103CD

Participants
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PURPOSE

To assess the feasibility of simultaneous multislice-accelerated diffusion-weighted imaging (SMS-DWI) of the rectum compared to conventional DWI (C-DWI) for rectal cancer patients.

METHOD AND MATERIALS

DWI of the rectum was performed for 65 patients with initially diagnosed rectal cancer. All patients underwent C-DWI and SMS-DWI with acceleration factors of 2 and 3 (SMS2-DWI and SMS3-DWI, respectively) using a 3 T machine. Acquisition times of three DWI sequences were measured. Image quality among the three DWI sequences was reviewed by two independent radiologists using a 4-point Likert scale and subsequently compared using the Friedman test. Apparent diffusion coefficient (ADC) values for rectal cancer and normal rectal wall were compared among the three sequences using repeated measures analysis of variance.

RESULTS

Acquisition times using SMS2-DWI and SMS3-DWI were 38.2% and 55.5%, respectively, shorter than those with C-DWI. For all image quality ratings other than distortion (image sharpness, artifact, lesion conspicuity, and overall image quality), C-DWI and SMS2-DWI produced better image qualities than did SMS3-DWI ($P < 0.001$), with no significant differences observed between C-DWI and SMS2-DWI ($P >= 0.054$). ADC values of rectal cancer ($P = 0.943$) and normal rectal wall ($P = 0.360$) were not significantly different among C-DWI, SMS2-DWI, and SMS3-DWI.

CONCLUSION

SMS-DWI using an acceleration factor of 2 is feasible for rectal MRI, resulting in substantial reductions in acquisition time while maintaining diagnostic image quality and ADC values similar to those with C-DWI.

CLINICAL RELEVANCE/APPLICATION

SMS-DWI using an acceleration factor of 2 can be incorporated into routine rectal MRI protocol, with shorter scan time and similar image quality compared to conventional DWI.

Printed on: 10/29/20

SSA10

Science Session with Keynote: Genitourinary (Benign Gynecologic Disease)

Sunday, Dec. 1 10:45AM - 12:15PM Room: N228

GU MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
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David D. Childs, MD, Clemmons, NC (*Moderator*) Nothing to Disclose
Elaine M. Caoili, MD, MS, Ann Arbor, MI (*Moderator*) Nothing to Disclose

Sub-Events

SSA10-01 Genitourinary Keynote Speaker: New Frontier in Imaging the Benign Female Pelvis

Sunday, Dec. 1 10:45AM - 10:55AM Room: N228

Participants
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SSA10-02 The Additional Value of Expertise and Structured Reporting in Pelvic MRI Assessment of Endometriosis: A Comparison of Three Review Methods for Diagnosis and Staging

Sunday, Dec. 1 10:55AM - 11:05AM Room: N228

Participants
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PURPOSE

To compare the diagnostic characteristics of Routine-Read, Structured-Reported read, and Structured Expert-Read pelvic MRI for the diagnosis and staging of pelvic endometriosis in a tertiary care academic medical center.

METHOD AND MATERIALS

530 patients with pathological confirmation of endometriosis were found from 2013-2018; 59/530 (11.1%) had surgical staging and adequate preoperative pelvic MRIs for review. Reports on file were considered routine-read (RR); MRI studies were independently reassessed with a structured-reporting template (SR) and by an structured expert reader (SER). Involvement was recorded by compartment [anterior (AC), middle (MC), posterior (PC), adnexal (AX), and other compartments (OC)]. Using surgical-pathologic staging as the gold standard, diagnostic discrepancy between the RR, SR and SER was assessed with the McNemar's test for paired nominal data. Agreement between SR and SER was assessed using Cohen's unweighted kappa.

RESULTS

295 compartments were assessed in 59 women (mean age= 38.8 y; range= 20-69) and 147/295 (49.8%) were involved surgically/pathologically. Diagnostic comparison results: (1) sensitivity: RR=42.9%; SR=86.4%; SER=74.2%. SR's increased sensitivity was significant for the PC, MC, AC (all, $p=0.001$) and AX ($p=0.038$) but not OC ($p>0.05$). Higher sensitivity by SER was significant for the PC and AC ($p<0.001$), and MC ($p=0.004$), but not AX or OC ($p>0.05$); (2) overall specificity: RR=95.3%; SR=45.9%; SER=81.8%. Neither SR nor SER found different results for specificity in OC ($p>0.5$) when compared to RR. RR sensitivity relied heavily on detection of AX involvement whereas SR and SER showed additional sites of disease (mainly in the PC, MC and AC), while maintaining a comparable specificity for SER. Agreement between SR and SER was fair at $k=0.342$ (95% CI: 0.25, 0.44).

CONCLUSION

Even at a tertiary care academic center, SER outperforms both SR and RR in the assessment of pelvic endometriosis. Although lack of expertise may reduce specificity, the use of a structured reporting template can significantly increase sensitivity the detection and staging of endometriosis; especially in the posterior, middle and anterior compartments.

CLINICAL RELEVANCE/APPLICATION

Structured reporting in conjunction with expertise can assist in surgical planning and counseling of patients living with endometriosis. MRI can play a vital role in surgical candidacy determination and surgeon selection.

SSA10-03 Vaginal and Rectal Gel Filling Improves the Diagnostic Performance of Endometriosis MRI in Detecting

Deep Infiltrating Peritoneal and Rectal Endometriosis

Sunday, Dec. 1 11:05AM - 11:15AM Room: N228

Participants
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PURPOSE

No consensus exists in the literature on the value of vaginal and rectal filling in the pre-operative MRI diagnostics of DIE. The aim of our study was to investigate this.

METHOD AND MATERIALS

103 patients, operated 2015-2017 with preoperative 1,5 T and 3 T pelvic MRI with or without vaginal and rectal gel opacification blinded to intraoperative findings were analyzed retrospectively by a specialized gynecologic radiologist and then compared to intraoperative findings by looking at the operation report, postoperative diagnosis and intraoperative images and videos. All lesions were histopathological proven (except bowel lesions not being resected). Statistical analysis was performed with SPSS (Vers 25.0) with ANOVA and Excel (Crosstabs, confusion matrix, correlation coefficient, T-test).

RESULTS

103 patients were analyzed, 45% with, 55% without gel filling. Mean age was 33,2 years (18-46), mean BMI 23.0 (16.1-36.8) and the women had a mean of 1,4 previous surgery. The prevalence of endometriosis in the study population was 0.80. 32.6% of the patients had a rASF °I and° II endometriosis, 55.9% °III and °IV. The detection accuracy of DIE improved significantly when proceeding MRI with vaginal and rectal gel filling (filling / non-filling group: Sens. 0.92/0.82, Spec. 0.56/0.41, PPV 0.89/0.84, NPV 0.63/0.38, Acc. 0.85/0.74). 22% of the patients underwent a bowel resection. The overall detection of rectal endometriosis (serosal, musc. propria, mucosal) was higher in the filling group (Correl. 0.68 vs. 0.46) and clearly superior in the detection of deeper rectal endometriosis (musc. propria and mucosal layers) : filling-group: Sens. 100%, NPP 100% / non-filling-group: Sens. 13%, NPP 53%. Sigma endometriosis was observed in 17/103 patients (17%), 9 of them underwent bowel resection.

CONCLUSION

Adapted MRI protocols with vaginal and rectal gel opacification lead to better preoperative diagnostic in peritoneal deep infiltrating endometriosis and in evaluation the depth of the intra-intestinal endometriosis. The feasibility of this so called 'MRI-jelly method' was high.

CLINICAL RELEVANCE/APPLICATION

For planning surgery and weighing the indication to bowel resection accurate pre-operative diagnostic of DIE is crucial. Adapted MRI protocol with vaginal and rectal gel application is recommendable non-invasive method.

SSA10-04 Uterine Junctional Zone Thickness in Patients with Intrauterine Device (IUD): Is There a Difference from the General Female Population?

Sunday, Dec. 1 11:15AM - 11:25AM Room: N228

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PURPOSE

Our purpose is to evaluate the thickness of the uterine junctional zone in patients with IUD and compare with literature values for the general female population.

METHOD AND MATERIALS

This is an observational retrospective IRB approved study. From the period of January 2016 until March 2018, 292 pelvic MRI of women of reproductive age (between 17 and 50 years old) and with IUD were evaluated. Exclusion criteria were direct signs of adenomyosis (periendometric cysts, adenomyomas and asymmetric thickening of the junctional zone). The thickness of the junctional zone was measured in the sagittal T2-weighted TSE sequences without fat suppression. In addition, the relationship between the thickness of the junctional zone and the thickness of the entire myometrium was measured at the same location.

RESULTS

The mean thickness of the junctional zone was 8 mm (range: 2 to 27 mm). The mean ratio of junctional zone thickness to myometrium thickness was 0.47 (range: 0 to 1.55). The junctional zone of 135 patients (46.2%) showed normal value thickness (< 7 mm). Moderate thickening (between 7 and 12 mm) of the junctional zone was seen in 136 women (46.6%). Exuberant thickening (> 12 mm) was seen in 21 patients (7.2%), with no other findings of adenomyosis. The relation between junctional zone thickness

and myometrium were 0.4 or less in 106 patients (36.3%) - within normal range based on the literature - and greater than 0.4 in 186 women (63.7%). When we compared our findings with normal values of the literature (normal up to 7 mm), the results showed to be statistically significant (p<0.001), suggesting that junctional zone of --patients with IUD is thicker).

CONCLUSION

IUD is associated with thickening of the uterine junctional zone beyond normal values, a finding that should not be mistaken for adenomyosis.

CLINICAL RELEVANCE/APPLICATION

The knowledge of new values --considered normal for the uterine junction zone thickness in patients with IUD helps to avoid the misdiagnosis of adenomyosis based on this indirect sign alone.

SSA10-05 Multi-parametric MR Relaxometry of Adenomyosis: Assessment of Symptom and Prediction of Response to Gonadotropin Releasing Hormone Analogue

Sunday, Dec. 1 11:25AM - 11:35AM Room: N228

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PURPOSE

To investigate whether MR relaxometry can evaluate symptoms of adenomyosis including dysmenorrhea and abnormal uterine bleeding, and to explore whether MR relaxometry can further predict the therapeutic response to gonadotropin releasing hormone analogue (GnRHa) in patients with adenomyosis.

METHOD AND MATERIALS

Between Nov 2017 and Aug 2018, 52 patients clinically diagnosed as adenomyosis underwent multi-parameter uterine MR examinations including T1, T2 and T2* relaxometry on a 3T MR scanner (Ingenia CX, Philips Healthcare, the Netherlands) during peri-ovulatory period. Visual analogue scale (VAS) of dysmenorrhea and blood hemoglobin level were collected before GnRHa injections and 6 months after. T1, T2, and T2* relaxation times of lesions were measured blindly by two radiologists via Intellispace Portal (version 10.1.0.64190, Philips Healthcare, the Netherlands) on slices showing maximum lesion area, as well as maximum diameters of lesions on sagittal T2W images. Spearman rank correlation coefficients were calculated to determine the relationship between relaxation times and VAS. Student t tests were performed to compare the difference of lesions' features between patients with different therapeutic responses. A p value <0.05 was considered statistically significant.

RESULTS

A moderate, negative correlation was found between T2* relaxation time of lesions and VAS (r=-0.4808, p=0.0004). Twenty-three patients received GnRHa injection, and 14 of them achieved complete response (CR, VAS=0 and normal Hgb) after 6 months, while 9 patients with partial response (PR, VAS>0 or anemia). T2* relaxation times of lesions were shorter in patients with CR than those with PR (43.73±2.019 ms vs. 55.43±5.465 ms, p=0.0295). Differences were found regarding T2 relaxation times and lesion maximum diameters but they were not statistically significant (63.12±1.913 ms vs. 71.07±3.685ms, p=0.0501, and 61.46±6.899 mm vs. 41.69±5.721 mm, respectively).

CONCLUSION

T2* relaxation time of lesions can quantitatively assess dysmenorrhea severity in patients with adenomyosis. Furthemore, T2* relaxometry showed potential as a quantitative imaging marker to predict GnRHa therapeutic response in patients with adenomyosis.

CLINICAL RELEVANCE/APPLICATION

T2* relaxometry can make both assessment and prediction as a non-invasive method, and guide different patients to GnRHa or other therapeutic plans based on different findings.

SSA10-06 Uterine Fibroid Embolization: MRI Texture Analysis as a Predictor of Radiological Outcome

Sunday, Dec. 1 11:35AM - 11:45AM Room: N228

Participants
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PURPOSE

To assess the association of morphologic and texture features on pre-embolization contrast-enhanced MRI with the radiological

response of uterine artery embolization (UAE) for uterine fibroids

METHOD AND MATERIALS

This retrospective study analysed the pre-embolization pelvic MRI studies of 80 patients that underwent UAE in our tertiary care centre. Cases were chosen to have good representation of two types of post MRI embolization response: 1) good - > 70% fibroid necrosis (48 cases) and 2) poor < 70% fibroid necrosis (32 cases). Quantitative differences of multiple texture parameters between the two groups were assessed on the venous phase of the pre-embolization MRI. The dominant fibroid on the venous phase was delineated in 3D with semi-automatic in-house software. Volume and six histogram-derived texture features (mean, variance, skewness, kurtosis, entropy, uniformity) were computed for each region of interest. Univariate t-tests were computed to test for statistical difference between the two outcome-based groups. Accounting for Bonferroni correction for multiple comparisons, features with $p<(0.05/7)=0.0071$ were selected and univariate diagnostic models were built separately for each selected feature. 95% confidence intervals were estimated using 1000 bootstrap iterations.

RESULTS

Three features with $p<0.0071$ were found, with the following diagnostic performance (95% confidence interval shown in parentheses): The AUC, Sensitivity and Specificity for Volume 0.86 (0.71,0.92) 0.88 (0.74,1.0) 0.79 (0.48,0.86) Mean 0.75 (0.63,0.85) 0.78 (0.53,0.94) 0.70 (0.29,0.78) Skewness 0.73 (0.59, 0.82) 0.44 (0.27,0.55) 0.76 (0.73,1.0) respectively.

CONCLUSION

Among the three selected features, volume appears to be the single best feature and outperformed other histogram-based texture features. In future work, we will collect an independent testing dataset, at which time machine learning techniques will be used to optimize a predictive model.

CLINICAL RELEVANCE/APPLICATION

Volume and regional texture features (mean, skewness) can help predict radiological outcomes of UAE and such studies may eventually allow better patient selection for UAE

SSA10-07 A Retrospective Study of the Ultrasound Characteristics of Surgically-proven Ovarian Torsion

Sunday, Dec. 1 11:45AM - 11:55AM Room: N228

Participants
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PURPOSE

Ovarian torsion can be a challenging diagnosis to confirm or exclude with ultrasound. In this 5-year retrospective study, we aimed to evaluate the ultrasound characteristics of the ovaries in women who underwent surgery for the presumed diagnosis of ovarian torsion.

METHOD AND MATERIALS

We queried our institution's electronic medical record system for all women who were admitted or discharged from two hospitals in our healthcare system between November 2012 and November 2017 and had an ICD-9 or ICD-10 code diagnosis of ovarian torsion. All patients who underwent surgery for the treatment of ovarian torsion were included in the study. The pre-surgical ultrasound studies were then reviewed by an attending radiologist and two radiology residents to determine ovarian volumes, ovarian parenchymal echotexture, ovarian color and spectral flow patterns, ovary location, ascites, presence of an adnexal mass, and presence of the whirlpool sign. We then reviewed the operative notes and corresponding pathology reports to determine which patients had confirmed ovarian torsion. Statistical analysis was performed using SAS.

RESULTS

A total of 64 patients were admitted or discharged with a diagnosis of ovarian torsion. Of these, 55 patients underwent surgery and were included in the analysis. The average patient age was 30 years old. At surgery, 39 patients had confirmed ovarian torsion (71%) and 16 did not (29%). The average volume of torsed ovaries was 202 ml (CI 125 - 279 ml) and for non-torsed ovaries 135 ml (CI 58 - 212 ml). The distribution of ovarian volumes was positively skewed, and no significant difference was found between the torsed ovaries and non-torsed ovaries ($P = 0.12$). The positive predictive values (PPV) were 86% for absent flow on color doppler, 79% for absent arterial flow on spectral doppler, and 75% for absent venous flow. PPV for the presence of heterogenous stroma was 74%, peripheral follicles 88%, presence of a mass 73%, moderate or large volume of ascites 80%, and for the whirlpool sign was 90%.

CONCLUSION

False positive rates remain high (29%), and no single sonographic finding is specific to ovarian torsion. Positive predictive values for common findings ranged from 75% for absent venous flow to 90% for whirlpool sign, which was only seen in 10 patients.

CLINICAL RELEVANCE/APPLICATION

Our results suggest evaluation of the vascular pedicle for whirlpool sign may be of utility when looking for ovarian torsion.

SSA10-08 Differentiation Between Ovarian Ischemia and Hemorrhagic Infarction by MRI in Cases of Adnexal Torsion

Sunday, Dec. 1 11:55AM - 12:05PM Room: N228

Participants
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PURPOSE

To demonstrate the role of magnetic resonance (MR) imaging findings, in differentiating between ovarian infarction and ischaemia and consequently the rate of ovarian salvage in cases of adnexal torsion.

METHOD AND MATERIALS

25 patients with surgically proven ovarian torsion were evaluated by two radiologists regarding the following MR findings: Ovarian enlargement, ovarian parenchymal hypointensity on T2-weighted images (WI), Hyperintensity on T1 (WI) with fat saturation, Recognition of twisted pedicle, Diffusion restriction and Ovarian parenchymal enhancement.. Also Pelvic fluid collection,and Uterine deviation These MR findings were statistically correlated with the operative findings and histopathological results (for cases of ovarian infarction).

RESULTS

Pathologically, ovarian haemorrhagic infarction was confirmed in 6 out of 25 cases. Ovarian hyposignal on T2 WI was seen in all cases with infarction 6/6. Ovarian hyperintensity (compared to the contralateral sides) was observed in 4/6 and 5/6 cases with infarction on T1WI and DWI, respectively Ovarian enlargement, fluid collections, uterine deviation and twisted pedicle were detected in most cases with or without haemorrhagic infarction. Poor parenchymal contrast enhancement was observed in all cases without or with necrosis

CONCLUSION

Detection of ovarian infarction is of prognostic importance in cases of torsion to assess salvageability, and thus may affect the surgical decision. Swollen hypointense ovarian parenchyma on T2 WI with lack of contrast uptake are the most reliable MRI signs, followed by hypersignal on T1 WI fat sat and DWI.

CLINICAL RELEVANCE/APPLICATION

MRI is not commonly employed as a first-line imaging study in suspected torsion, but can be very helpful in pregnant patients with an inconclusive US or as a problem solver in equivocal cases. It is important to assess salvageablity of the torsed ovary preoperatively.

SSA10-09 Prevalence of Pathologies in Infertile Women Identified by MR Virtual Hysterosalpingography

Sunday, Dec. 1 12:05PM - 12:15PM Room: N228

Participants
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PURPOSE

CT Virtual Hysterosalpingography (CT-VHSG) emerged as a good non-invasive modality to evaluate the gynecologist system using very low radiation dose. Recently MR-Virtual Hysterosalpingography (MR-VHSG) appears with the advantage of lacking of ionizing radiation. The objective of this paper is to evaluate the usefulness of MR-VHSG in infertility versus CT-VHSG, and determine the prevalence of disease in each anatomic region of the gynecologist system.

METHOD AND MATERIALS

Patients were studied by CT-VHSG and MR-VHSG. CT studies were performed in a 128-slice CT scanner (Discovery CT750 HD, GE Healthcare) and MR studies in a high filed 3T scanner (Discovery HXT, GE Healthcare). Findings in each modality were reported by two different radiologists in a blinded fashion according to different anatomic regions: cervix, uterine wall, uterine cavity and fallopian tubes. Sensitivity (S), Specificity (SP), Positive Predictive Value (PPV) and Negative predictive Value (NPV) were determined by the exact binomial method for each region. Disease prevalence was reported in each region.

RESULTS

Fifty two infertile women were studied. In the cervix, 21 patients presented pathological findings: 6 polyps, 6 C-section scars, 3 stenosis,1 sinequiae, 7 hypertrophic folds, 5 glandular dilatation. Prevalence of disease: 9,77 %. Per patient S, Sp, PPV and NPV were: 96%, 95%,96% and 95%. Per lesion S, Sp, PPV and NPV were 89%, 95%, 92%, 98%. In the uterine wall, 6 patients presented anomalies (1 septate, 3 unicorn, 2 arcuate uterus). S, Sp, PPV and NPV 100%. In uterine cavity, 13 patients presented pathology (6 polyps,1 submucosal myoma, 5 sinequiae,1 hyperplasic folds). Disease prevalence 5.24 %. Per patient S, Sp, PPV and NPV were 100%, 94%, 85%, 100%. Per lesion S, Sp, PPV and NPV were 92%, 98%, 80%, 99%. In the fallopian tubes 8 patients presented pathology: tubal occlusion, dilatation, hidrosalpinx and negative Cotte. Per patient, S, Sp, PPV and NPV were 82%, 92%,72%, 97%. Disease prevalence 17,65%. Per lesion S, Sp, PPV and NPV were 88%, 99%, 88%, 99%.

CONCLUSION

MR-VHSG showed very good results in the evaluation of the gynecological system. These promising results should be validated in a larger number of patients so as to determine its the role in clinical work.

CLINICAL RELEVANCE/APPLICATION

MR-VHSG is a promising, ionizing radiation-free examination for the evaluation of the infertile woman.

SSA11

Genitourinary (Renal Neoplasia)

Sunday, Dec. 1 10:45AM - 12:15PM Room: N230B

CT GU

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSA11-01 Diagnostic Accuracy of the Clear Cell Likelihood Score (ccLS) in Clinical Practice: Impact of Tumor Stage

Sunday, Dec. 1 10:45AM - 10:55AM Room: N230B

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PURPOSE

The paradoxical lack of decreased mortality from renal cell carcinoma despite the increased incidental detection of renal masses demonstrates a need for risk stratification prior to intervention. As the most common and aggressive histologic subtype, identification of clear cell renal cell carcinoma (ccRCC) during radiologic evaluation would be valuable. Previous work has shown the predictive value of a clear cell likelihood score (ccLS) derived from multiparametric magnetic resonance imaging (mpMRI). Here we assess the prospective performance of ccLS for renal masses across all stages in clinical practice.

METHOD AND MATERIALS

We conducted a retrospective, multi-institution analysis of prospectively generated clinical data. The ccLS was incorporated into the clinical report of mpMRI at 2 different institutions in 06/2016. Prospectively assigned ccLS of renal masses evaluated between 06/2016 and 10/2018 were reviewed. ccLS were correlated with histologic diagnosis when available. Diagnostic performance for diagnosing ccRCC and post-test probabilities of ccLS were quantified by contingency table analysis.

RESULTS

634 mpMRIs were obtained for renal mass evaluation and prospectively assigned ccLS by 1 of 16 fellowship-trained radiologists. Of these, 255 renal masses (244 patients) had pathologic tissue diagnosis after the mpMRI via renal biopsy (34) or surgical excision (221) and represent the study cohort. Overall, 24% were ccLS 1-2, 12% ccLS 3, and 64% ccLS 4-5. 45.1% of the masses were clinical stage T1a, 24.7% T1b, 3.5% T2, 24.3% T3, 2.4% T4. The figure shows the distribution of histologic diagnosis across ccLS. The sensitivity and specificity of ccLS >=4 in diagnosing ccRCC are 87.8% and 80.2%, respectively. The sensitivity and specificity of ccLS >=3 in diagnosing ccRCC are 98.2% and 64.8%, respectively. Diagnostic accuracy improved in higher stage tumors (Cochran-Armitage trend test, p = 0.0025).

CONCLUSION

A non-invasive diagnosis of ccRCC in patients with renal masses using mpMRI can be achieved with reasonable clinical performance in a busy clinical practice with a large number of interpreting radiologists. ccLS performance improved in larger tumors.

CLINICAL RELEVANCE/APPLICATION

Implementation of ccLS in clinical practice can help reduce the number of renal biopsies prior to surgical resection (95.1% of ccLS 4-5 were malignant). Histologic prediction with mpMRI is improved in larger tumors.

SSA11-02 Infiltrative Renal Masses: Are We Reporting What's There? Impact on Patient Outcome

Sunday, Dec. 1 10:55AM - 11:05AM Room: N230B

Participants
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PURPOSE

To determine the prospective reporting rate of infiltrative features in radiologically identified renal masses and to evaluate the impact on patient outcomes.

METHOD AND MATERIALS

522 patients with renal tumors managed with partial or radical nephrectomy (2012-2014) with locally-advanced and/or aggressive histology were analyzed. Preoperative CT/MRI were retrospectively, independently reviewed by 2 radiologists. Infiltrative renal masses (IRM) were defined as having poorly-defined interface with parenchyma and non-elliptical shape in one or more distinct and unequivocal areas and features were identified as extensive or focal. Cancer-specific mortality (CSM) was estimated using Kaplan-Meier. Significant, independent predictors of CSM were evaluated using Cox-proportional-hazards analysis.

RESULTS

Image-review confirmed 133 IRMs (25%), including 103 RCCs, 59 with sarcomatoid or poorly-differentiated features on pathology. IRMs were larger and more often symptomatic compared to non-IRMs, and disseminated-disease was also more common (all $p<0.001$). Overall, 109 IRMs were imaged at our center; 42 were documented as IRM in preoperative radiology reports, while infiltrative features were not documented in 67 (61%). Only 4 (6%) of these 67 were documented as infiltrative by the surgical team. 2-year CSM was 29% and 6% for IRM and non-IRM patients, respectively ($p<0.001$, Figure A). CSM difference was found documented versus undocumented IRMs ($p=0.04$, Figure B) and both showed significantly increased CSM compared to non-IRMs (both $p<0.001$). Among IRMs, extensive infiltrative-features and disseminated-disease were associated with CSM, while documentation-status failed to associate. Among IRMs, extensive infiltrative-features and disseminated-disease were associated with CSM, while documentation-status failed to associate.

CONCLUSION

Twenty-five percent of locally-advanced and/or histologically-aggressive renal tumors exhibited infiltrative features, although many were not documented prospectively. Even within this high-risk population, infiltrative-features were independent predictors of CSM, whether documented or not.

CLINICAL RELEVANCE/APPLICATION

Infiltrative features in renal tumors have a strong impact on patient prognosis and should be routinely assessed and documented during radiologic evaluation of renal masses.

SSA11-03 Evaluating Distribution of Renal Tumor Growth Rate in Hereditary Cancers: A Single Center Study

Sunday, Dec. 1 11:05AM - 11:15AM Room: N230B

Participants
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PURPOSE

To investigate the distribution of growth rate across different subtypes and sizes of renal tumors associated with hereditary renal cancers, using serial volumetric imaging.

METHOD AND MATERIALS

A registry of patients with hereditary renal cancers was retrospectively reviewed for patients with a minimum of two preoperative cross-sectional imaging. Longest diameter of the tumor was measured for all time points using less than 3 mm slice thickness CT in corticomedullary phase of high-resolution T2-WI MRI. Tumor growth rate between every two consecutive instances of imaging was calculated using the same modality (CT/MRI), and was used as a data point for statistical evaluation. Association between tumor size at each instance and its subsequent growth rate was analyzed using repeated-measures statistical models, which were also used to compare growth rates across renal tumor subtypes.

RESULTS

Images included 1142 CT scans and 734 MRI. Tumors included pathologically confirmed cases of Clear Cell renal cell carcinoma

(ccRCC, n=197), Papillary type 1 (n=47), and Oncocytoma (n=12) from patients with Von Hippel-Lindau syndrome (n=75), Hereditary Papillary Renal Carcinoma (n=13), and Birt-Hogg-Dube syndrome (n=7). The number of pairs of consecutive of measurements, their median growth rate (in mm per 365 days), and interquartile range were: n=777, median=2.35, IQR=(0.00, 6.67) for ccRCC; n=134, median=1.00, IQR=(0.00, 4.66) for Papillary Type I; and n=27, median=1.44, IQR=(0.00, 4.89) for Oncocytoma. The data did not show any evidence of an association between tumor size at presentation and its subsequent growth rate, for any of the 3 subtypes. There was no evidence of average tumor growth rates being different between tumor subtypes in hereditary renal tumors. Based on all 3 subtypes combined (n=938), the median growth rate was 1.97 mm per 365 days, with an interquartile range of (0.00, 6.27).

CONCLUSION

The data analyzed showed no evidence of an association between renal tumor growth rate and tumor size in ccRCC, Papillary, and oncocytoma associated with hereditary renal syndromes, and showed no evidence of a difference in average growth rate among the 3 subtypes.

CLINICAL RELEVANCE/APPLICATION

Tumor size at presentation measured on serial images does not seem to be a reliable measure to estimate future growth, hence it is not suggested as a marker to schedule surveillance frequency of renal masses associated with hereditary renal cancers.

SSA11-04 The Arrowhead Sign (AS) a Novel, Reproducible Radiographic Indicator of Intramuscular Venous Branch Invasion (pT3a) in Patients with Renal Cell Carcinoma

Sunday, Dec. 1 11:15AM - 11:25AM Room: N230B

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PURPOSE

Accurate preoperative prediction of T3a disease in renal cell carcinoma (RCC) is a clinical challenge. Knowledge of renal intramuscular venous invasion can influence clinical decision-making regarding the suitability of nephron-sparing surgery. We report and validate the observation that tumors that exhibit invasion into the muscular branches of the venous vasculature form a 'beak-shaped' irregularity as they grow towards the renal sinus fat and resembles an 'arrowhead'. We sought to determine if the 'Arrowhead Sign (AS)' CT finding could be used as a preoperative predictor of proximal venous invasion on final histopathologic evaluation

METHOD AND MATERIALS

We queried our IRB-approved, kidney cancer database and identified 174 patients with localized renal tumors who underwent surgical resection between 2009 and 2018 and had a pre-operative contrast imaging within 90 days of surgery. Two fellowship-trained junior abdominal radiologists and a senior radiologist with 25 years of experience blindly and independently reviewed the imaging. To evaluate for likelihood of tumor venous invasion on final histopathology, images were assessed for the following radiographic predictors of cT3a disease: sinus fat infiltration, perinephric invasion, and AS.Indicators were scored on a 1- 4 scale according to reader's degree of confidence in the finding, with a score of 1 - definitely present,to 4 - definitely absent. Statistical analyses were performed.

RESULTS

Final pathologic staging revealed pT1=116 (66.6%), pT2=9 (5.1%), pT3=48 (27.5%) and pT4=1 (0.006%). The sensitivity and specificity of AS for predicting muscular venous invasion were 92% and 73%, respectively. Perinephric invasion had 62% sensitivity and 85% specificity, while sinus fat infiltration was 89% sensitive and 73% specific. Inter-reader agreement for AS was moderate (x = 0.64).

CONCLUSION

The arrowhead sign is a novel and potentially clinically actionable predictor of muscular venous invasion in patients with RCC. Of the three indicators, it had the highest sensitivity and moderate intra-reader agreement. These initial findings justify further investigation.

CLINICAL RELEVANCE/APPLICATION

The ability to stage pT3a (RCC) with imaging can influence surgical management and eligibility for clinical trials. Of the three commonly reported imaging features the,' arrowhead sign,' had the highest sensitivity and larger validation studies are warranted.

SSA11-05 Renal Mass Characterization with Dual-energy CT: Validation of a Dual-layer Spectral CT Platform in an Anthropomorphic Renal Phantom Model

Sunday, Dec. 1 11:25AM - 11:35AM Room: N230B

Participants
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PURPOSE

To validate the application of a dual-layer spectral CT platform for renal mass characterization using dual-energy CT (DECT).

METHOD AND MATERIALS

A custom renal phantom model consisting of three cylinders simulating unenhanced state (A) (0 mgI/mL), nephrographic (B) (7 mgI/mL) and excretory phases (C) of the kidneys (5 mgI/ml) was used. In addition, six rods were fabricated to mimic simple and hyperdense cysts (0 mgI/mL), unenhanced (0 mgI/mL) and contrast-enhanced minimally- (0.5 mgI/mL), moderately- (1 mgI/mL), and avidly-enhancing (3 mgI/mL) solid renal masses (labelled 1-6 respectively). Simulated kidneys with varying renal masses were inserted into an anthropomorphic human phantom (ATOM 701, CIRS Inc.) in three body sizes (small, medium, large) and scanned with 120 kV single-energy and dual-energy CT using a dual-layer spectral CT (IQon Spectral CT; Philips Healthcare). For each scan, full radiation dose and 40% radiation dose-reduced acquisitions were obtained. Single-energy, dual-energy 70 keV monochromatic and iodine maps were reconstructed and computed. The effect of body habitus and radiation exposure on renal mass characterization was also assessed.

RESULTS

Consistent and statistically significant attenuation differences were observed between the unenhanced, minimally-, moderately-, and avidly- enhancing lesions ($p<0.05$ for all comparisons) without variation between the small and medium body sizes. No statistically significant attenuation difference was found among the renal lesions when standard radiation dose was compared to 40% reduced dose with the exception of the moderately enhancing renal lesion in nephrographic phase in a small body size. Iodine quantification was variable with statistical significance between phase of contrast, body size and radiation dose.

CONCLUSION

Attenuation changes calculated from dual energy CT data using a dual-layer platform can be used to differentiate among different renal lesion types, without significant variation with different radiation dose levels. However, the iodine quantification technique shows significant variation as a function of study phase, body size and radiation dose.

CLINICAL RELEVANCE/APPLICATION

Radiation dose reduced acquisition can be implemented for renal mass characterization with DECT on a dual-layer platform. However, circumspection should be paid when using the iodine quantification with different study phases, body size and radiation dose levels.

SSA11-06 Cost-Effectiveness of Dual-Energy CT Versus MRI for Characterization of Small Incidental Indeterminate Renal Lesions

Sunday, Dec. 1 11:35AM - 11:45AM Room: N230B

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PURPOSE

To develop a Markov Monte Carlo decision-analytic model to evaluate the cost effectiveness of dual-energy (DE) CT versus multiphasic single-energy (SE) CT and MRI for characterizing small incidentally detected indeterminate renal lesions.

METHOD AND MATERIALS

A decision analytic Markov model was constructed to estimate life expectancy and lifetime costs for otherwise healthy 64-year-old patients with small (<= 4 cm) incidentally detected, indeterminate renal lesions on routine imaging (e.g. ultrasound or single-phase CT). Three strategies for evaluating renal lesions for enhancement were compared: multiphase SECT (e.g. true unenhanced and nephrographic phase), multiphasic MRI, and single-phase DECT (nephrographic phase only in dual-energy mode). Model incorporated modality specific diagnostic performance, incidence and prevalence of incidental renal cell carcinomas (RCCs), effectiveness, costs, and outcomes. An incremental cost-effectiveness analysis was performed to identify strategy preference at a willingness-to-pay (WTP) thresholds of $50,000 and $100,000 per quality-adjusted life-year (QALY) gained. Deterministic and probabilistic sensitivity analysis were performed by using Monte Carlo simulations (100,000 runs).

RESULTS

Under the base-case assumptions, DECT was the dominant strategy as it was most cost-effective with a higher effectiveness (mean 0.95) and lower cost ($2108) compared to MRI (mean of 0.93 and $3105) and multiphasic SECT (0.93 and $2851). Results were robust to changes in model parameters based on sensitivity analysis. The probability that the single-phase DECT imaging strategy was cost-effective was 76% at a willingness to pay of $50,000/QALY.

CONCLUSION

Dual-energy CT is more cost-effective than multiphasic single-energy CT and MRI for characterizing small incidentally detected indeterminate renal lesions.

CLINICAL RELEVANCE/APPLICATION

Incidental indeterminate renal lesions are commonly encountered and often warrant additional imaging workup. DECT is a more cost-effective than MRI and SECT to determine whether there is renal lesion enhancement and should be considered the preferred workup strategy.

SSA11-07 Apparent Diffusion Coefficient Predicts Malignancy in T1-Hyperintense Small Renal Masses

Sunday, Dec. 1 11:45AM - 11:55AM Room: N230B

Participants
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PURPOSE

Small renal masses (<4 cm) can be difficult to accurately classify as benign or malignant, particularly if they are T1 hyperintense on MRI. This intrinsic signal, potentially related to intralesional hemorrhage, may limit evaluation of contrast enhancement and signal intensity on other sequences. The purpose of this study was to test whether apparent diffusion coefficient (ADC) measurements may predict malignancy.

METHOD AND MATERIALS

This IRB-approved single-center retrospective study identified patients with a T1-hyperintense renal mass less than 4 cm on MRI. Malignant lesions were pathologically proven; a benign mass was established by a predefined hierarchy of pathologic proof, follow-up ultrasound, or follow-up imaging (MR/CT) showing more than 5 years of stability. T1 hyperintensity, defined as a signal intensity equivalent to or greater than the adjacent cortex, was confirmed by an abdominal radiologist with over 20 years of abdominal imaging experience. Two additional abdominal radiologists independently measured ADC values by drawing the largest region of interest within the lesion. This was normalized to the ADC of the ipsilateral background kidney (i.e. ADClesion / ADCipsilateral) and represented as ADCratio. (Figure). Inter-reader reliability was assessed using intra-class correlation coefficient (ICC). Multivariate binary logistic regression was used to control for lesion size.

RESULTS

There were 58 benign and 37 malignant renal lesions in 95 patients (51 [54%] males; age 61 ± 13 years; size 1.9 ± 0.9 cm). Inter-reader agreement for lesion and ipsilateral kidney was excellent (ICC of 0.94 [CI: 0.91, 0.96] and 0.84 [CI: 0.76, 0.89] respectively). ADCratio was significantly lower in malignant compared to benign lesions (0.65 ± 0.29 vs. 1.03 ± 0.32, $p<0.001$ [Figure]). Malignant lesions were significantly larger than benign lesions (2.7 ± 0.9 vs. 1.5 ± 0.6 cm, $p<0.001$). After controlling for lesion size, ADCratio remained a significant predictor of malignancy; each 0.1 unit decrease in ADCratio conferred a 1.49 times higher odds of malignancy (95% CI: 1.20, 1.84; $p<0.001$).

CONCLUSION

ADCratio is a significant predictor of malignancy in small T1-hyperintense renal lesions.

CLINICAL RELEVANCE/APPLICATION

Small renal masses with intrinsic T1 hyperintensity on MRI can be difficult to classify as benign versus malignant. ADCratio may serve as a useful differentiating feature.

SSA11-08 Accuracy of Contrast-enhanced Ultrasound for Characterization of Complex Cystic Renal Masses and Its Agreement with CT for the Bosniak Classification

Sunday, Dec. 1 11:55AM - 12:05PM Room: N230B

Participants
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PURPOSE

To evaluate the diagnostic accuracy of contrast-enhanced ultrasound (CEUS) for characterization of complex cystic renal masses according to Bosniak classification system and its agreement with CT.

METHOD AND MATERIALS

This prospective study approved by the Institutional Review Board comprised of 50 patients with complex cystic renal masses, detected on gray-scale ultrasound. All patients were evaluated by both CEUS and CT, after obtaining informed consent. CEUS was performed on a single ultrasound machine with a 1-6 MHz curvilinear using second generation contrast agent. Contrast CT was performed on the same 128-slice scanner in all patients. All patients were classified according to the Bosniak classification using both modalities. Imaging follow up was performed for Bosniak II and IIF lesions and histopathological diagnosis was obtained for Bosniak III and IV lesions. Mc Nemar test was used to compare sensitivity and specificity of the two methods. p value < 0.05 was considered statistically significant. Inter rater kappa agreement was used to find out agreement between CEUS and CT.

RESULTS

Out of 50 patients, 12 were female and 38 were male with ages ranging from 18 to 78 years. On CEUS, complex cysts were characterized as follows: 18 as Bosniak II, 18 as Bosniak IIF, 10 as Bosniak III and 4 as Bosniak IV. On CT, these complex cysts were characterized as follows: 20 as Bosniak II, 16 as Bosniak IIF, 12 as Bosniak III and 2 as Bosniak IV. CEUS upgraded two Bosniak II cysts into Bosniak IIF and two Bosniak III cysts into Bosniak IV. Mean septal thickness and mean number of septae was significantly higher on CEUS as compared to CT (p value < 0.05). Strength of agreement was excellent (k value of 0.818) between the two modalities for all categories of Bosniak classification.

CONCLUSION

CEUS has similar diagnostic accuracy to CT in characterization complex cystic renal masses for all categories of Bosniak classification.

CLINICAL RELEVANCE/APPLICATION

In patients with complex renal cysts, CEUS can be used as safer alternative to CT to prevent radiation exposure and for those with chronic kidney disease, where iodinated contrast is contraindicated.

SSA11-09 Morphometric Image Analysis Predicts Surgical Outcomes During Level II-IV Level Inferior Vena Cava Tumor Thrombectomy

Sunday, Dec. 1 12:05PM - 12:15PM Room: N230B

Participants
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PURPOSE

To assess if the scored morphometric analysis of renal vein and Inferior Vena Cava (IVC) tumor thrombus diameters and renal cell carcinoma (RCC) volume extracted from preoperative CECT and MRI can predict surgical outcomes and complications of level II-IV IVC tumor thrombectomy.

METHOD AND MATERIALS

In this IRB approved, HIPAA compliant retrospective study, we queried CECT and MRI imaging studies of 83 patients performed over a 10-year window (Nov 2007 - Dec 2017). Manual segmentation of the venous thrombus was performed by an experienced radiologist in Synapse 3D. The 3D regions of interest (ROIs) included IVC, renal vein, thrombus and renal mass. Segmental volumetric-analysis was performed separately on the suprarenal and infrarenal IVC, the caval thrombus volume included both tumor as well as bland thrombus. In all cases, maximum diameter of the IVC and renal vein, as well maximal bowing of the IVC and renal vein ostium diameter were measured. The radiological variables were compared to a measure of complications captured by Clavien-Dindo (CD) score. Random forest was used as the machine learning tool to build the composite prediction models with all candidate predictors. Leave-one-out procedure was used to assess the robust prediction accuracy. Area under the curve was used to assess the prediction accuracy for binary surgical outcome and R2 was used for continuous outcome.

RESULTS

Five composite prediction models were built using random forest. The leave-one-out validation showed that the composite prediction models using imaging-based morphometric predictors alone can achieve a robust and statistically significant AUC=0.7 95% CI (0.58 0.81) in predicting CD. We also found that the models can robustly explain significant amount of total variance of natural log-transformed (ln) ln(Estimated Blood loss): 15% (p<0.01); ln(Number of units transfused): 7% (p=0.01); ln (Operation time): 6% (p=0.02) and ln(Trans): 5% (p=0.06).

CONCLUSION

Imaging-based morphometric models can be accurately used to predict surgical outcomes and complications. This can be used to assist with surgical planning and patient counseling.

CLINICAL RELEVANCE/APPLICATION

Radiologic morphometric analysis in patients with RCC with level II-IV IVC thrombus can help predict surgical outcomes and complications.

SSA12

Science Session with Keynote: Informatics (Artificial Intelligence: Cutting Edge Artificial Intelligence)

Sunday, Dec. 1 10:45AM - 12:15PM Room: E450A

AI IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

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Sub-Events

SSA12-01 Informatics Keynote Speaker: The French Radiology AI Data Hub

Sunday, Dec. 1 10:45AM - 10:55AM Room: E450A

Participants
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SSA12-02 FalcoNet-GMC: A 3D Convolutional Neural Network Module for Instance Segmentation and Quantification of Distant Recurrence from Gynecological Cancers

Sunday, Dec. 1 10:55AM - 11:05AM Room: E450A

Participants
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CONCLUSION

A multifunctional web-based auxiliary system for distant recurrence from gynecologic cancer will enhance the early detection for salvage treatment, with better segmentation by compartment weight maps.

Background

Early detection of distant recurrence in the lung and thoracic lymph nodes is critical for successful salvage treatment for gynecological cancers. We introduce a novel web-based auxiliary system for ovarian and cervical cancer spread to chest, featuring: (1) A novel 3D convolutional neural network (CNN) named CompartNets for delineation of lung/lymph node metastases; (2) A 3D CNN for segmentation of lung, trachea, esophagus, heart, aorta, and spinal cord; (3) A 3D-based radiomic quantification module, VQM (Volumetric Quantification Master).

Evaluation

Contrast-enhanced CT of 40 ovarian cancers and 60 cervical cancers with distant recurrence were recruited as training dataset. Two board-certified radiologists manually delineated the lesion contours as ground truth. A 3D ESPNet model was trained for organ segmentation to generate compartment weight maps. Second, two 3D RetinaESPNets were pretrained on The Cancer Imaging Archive (TCIA). Transfer learning was conducted to detect distant recurrence. Independent testing was carried out in randomly selected 8 ovarian cancer and 12 cervical cancer patients. The segmentation of CompartNet was compared with pure 3D RetinaESPNet without compartment maps and pure 3D ESPNet without detection. The recall/precision reached 97%/93% for pulmonary recurrence and 91%/87% for nodal recurrence, respectively. For segmentation of lung/lymph node recurrence, the intersection over union (IoU) score of CompartNets reached 0.93/0.93, compared with 0.89/0.88 of pure RetinaESPNets and 0.77/0.77 of pure ESPNet. The mean IoU of organ segmentation was 0.93.

Discussion

The IoUs of CompartNets are improved compared with pure RetinaESPNets, owing to loss weighting of normal compartments, which are indecipherable within tumor bounding box. With organ segmentation and lesion-based VQM, our system can differentiate locations of metastases between mediastinum, lung, and chest wall.

SSA12-03 Automated Detection of Vertebral Fractures in CT Using 3D Convolutional Neural Networks

Sunday, Dec. 1 11:05AM - 11:15AM Room: E450A

Participants

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CONCLUSION

Our method achieves an AUC of 0.95±0.02 outperforming Valentinitsch et al. We also illustrate that our method achieves higher recall (0.905) on the operating point reported by Bar et al. The results of our 5-fold cross-validation experiment demonstrate that our 3D data-driven method compares favourably to state-of-the-art using 2.5D learned features and 3D engineered features. The small sample size and use of cross-validation are limitations of this proof-of-concept. This will be adressed in a larger follow up study, currently ongoing.

Background

We present a data-driven approach to automatically detect vertebral fractures in spine-containing CT images. Inspired by radiology practice, existing methods are based on 2D and 2.5D features but we present, to the best of our knowledge, the first method learning 3D features for detecting vertebral fractures.

Evaluation

For this study, we build a training database of 90 de-identified CT image series. These images were acquired on three different scanners (Siemens, Philips and General Electric; 120 kVp tube voltage; maximum in-plane spacing and slice thickness are respectively 0.92mm x 0.92mm and 1.5mm) and contain 90 patients scanned for various indications (average age: 81 years, range: 70 - 101 years, 64% female patients, 12% negative cases). We present a two-staged vertebra fracture detection method that first predicts a class probability for every voxel using a 3D CNN and secondly aggregates this information to a patient-level fracture prediction.

Discussion

We performed a stratified 5-fold cross-validation to estimate the expected performance of our 3D method. For each run, we selected 15% of the images in the training folds as validation samples to determine when to stop training based on validation performance. We report the ROC curve because this metric describes model performance independently of the class distribution and is well suited to compare results from different test sets. Since our method involves two hyperparameters that can be chosen to deliver distinct classifiers, we build the ROC curve using the convex hull representing the optimal classifiers from a group of potential classifiers.

SSA12-04 Universal High Performance Pelvic/Hip Fracture Detection on Pelvic Radiographs of Trauma Patients Using Cascaded Deep Networks

Sunday, Dec. 1 11:15AM - 11:25AM Room: E450A

Participants
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PURPOSE

Detecting fracture from pelvic radiographs is an important yet challenging task because of the high variety of possible fracture types in hip and pelvis. Existing detection methods only detect hip fracture and do not address the more complex pelvic fracture. We propose a universal fracture detector via two-stage cascaded deep neural network that is capable of handling both pelvic and hip fractures.

METHOD AND MATERIALS

Our method is developed using 4,410 pelvic radiographs (1,975 hip fractures, 801 pelvic fractures and 1,630 images without fractures) with only image level fracture labels. The first stage deep network mines the potential fracture regions of interest (ROIs) from the whole image globally, which are then examined locally by the second network to classify the fracture and type (i.e., pelvic/hip fracture) per local ROI. A fracture probability heatmap is produced to indicate potential fracture sites. We recruit 17 primary physicians (emergency physician and surgeon) and 6 consulting physicians (orthopedic specialist and radiologist) to review an independent test dataset of 150 pelvic radiographs (50 hip fractures, 50 pelvic fractures, and 50 without fractures), and compare the detection results from the physicians with the proposed model.

RESULTS

Our two-stage 'global-to-local' cascaded deep neural network achieves an accuracy of 0.907 in the independent testing dataset, which is comparable with the primary physicians (0.882, IQR[0.863-0.923]), but slightly lower than consulting physicians. The model

sensitivity and specificity are 0.962 and 0.938 for the hip fracture, 0.842 and 0.953 for the pelvic fracture. For all physicians, the model may avoid 2.17% missed hip fracture, and 7.74% missed pelvic fracture. For the primary physicians, the model may avoid 2.82% missed hip fracture, and 9.18% missed pelvic fracture. The fracture heatmaps consistently show correct fracture sites for true positive detection cases.

CONCLUSION

We propose an algorithm to detect pelvic and hip fractures from pelvic radiographs. It consistently and significantly outperforms previous automated methods and is a promising tool to avoid misdiagnosis by physicians.

CLINICAL RELEVANCE/APPLICATION

Our method provides accurate diagnosis of both hip and pelvic fractures in pelvic radiographies. It also produces fracture location heatmap to assist physicians to identify potential fracture sites.

SSA12-05 Defacing Neuroimages

Sunday, Dec. 1 11:25AM - 11:35AM Room: E450A

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CONCLUSION

The present model was trained to deface brain CTs and also worked well for FLAIR images. The image binarization preprocessing step shows a promising approach of "train one, earn many", that could potentially be extended to all MRI sequences, not only FLAIR. This work demonstrates the use of AI to protect patient privacy, allowing the use of head CTs in open databases for worldwide collaboration in machine learning projects.

Background

The Health Insurance Portability and Accountability Act (HIPAA) defines 18 identifiers as protected health information that need to be removed from healthcare exams, including 'full face photographic images and any comparable images'. This raises the concern about the possibility of patient identification by 3D rendering of head CTs or brain MRIs. There is a need for sharing imaging data for open collaboration while ensuring the patient's privacy. In this context, image de-identification has become a necessity. We propose a two-step deep learning model to automatically deface head CTs and brain MRIs.

Evaluation

This study was approved by our institutional review board, and written informed consent was waived. A total of 1123 axial brain CT studies were anonymized. Manual segmentation of the face was done using bounding boxes in each slice using md.ai (md.ai, New York). Masks were generated from the bounding boxes and the CTs werebinarized. The first model consists of a binary classification (NASNet mobile) that predicts if that slice contains a face or not. The second step is a Unet trained to segment the face only in the slices that had faces. The final performance was evaluated with AUC, Dice Similarity Coefficient and visual inspection. The same model trained on binarized CTs was tested on FLAIR (630 studies) and in an external batch of CTs (500 studies).

Discussion

Step one resulted in a model with an AUC of 0.999 in the test set. Step two resulted in a Dice Coefficient score of 0.97/0.93/0.91 in the train/validation/test sets, respectively. Visual inspection of the head CTs from the test set and the external batch showed 100% defacing and on FLAIR resulted in 99.5% defacing.

SSA12-06 Automated Detection and Delineation of Hepatocellular Carcinoma on Multiphasic Contrast-Enhanced MRI Using Deep Learning

Sunday, Dec. 1 11:35AM - 11:45AM Room: E450A

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PURPOSE

The Liver Imaging Reporting and Data System (LI-RADS) uses multiphasic contrast-enhanced (CE) imaging for diagnosis of hepatocellular carcinoma (HCC). In order to make the workflow more efficient and to provide a first benchmark for this modality, a deep learning algorithm was trained to segment the liver and HCC based on CE-MRI.

METHOD AND MATERIALS

A single deep convolutional neural network (DCNN) for liver segmentation and HCC delineation was trained on late arterial (25-30s), portal venous (60-70s) and delayed phase (3 min) CE-MRI. The U-Net was chosen as the DCNN's architecture and recent optimizations (residual blocks, Leaky ReLUs, instance normalization) were adopted. The network was presented with stacks of adjacent axial slices across the three phases. The U-Net was trained (70%), validated (15%) and tested (15%) on a dataset consisting of 174 patients with 231 lesions. Manual 3D segmentations of the liver and HCC made by a board-certified radiologist served as ground truth. The dice similarity coefficient (DSC) was measured between the manual and automated methods. In addition to the U-Net, a random forests classifier employing radiomic features (RF) and thresholding (TR) the mean activation of a segmentation were used to reduce the false positive rate (FPR).

RESULTS

The algorithm detected 73% and 75% of HCC on validation and test sets, respectively, using a DSC criterion between the individual lesion and corresponding segmentation of >0.2. The FPR on the validation set were 2.81, 0.77, and 0.85 for the U-Net, U-Net+RF, and U-Net+TR, respectively. A combination of all methods (U-Net+RF+TR) further improved the FPR to 0.62 and on the test set, it was 0.75. Mean DSC/case was 0.49 and 0.48 on validation/test. Mean DSC between detected lesions and corresponding segmentation was 0.64/0.68. Liver segmentations had a mean DSC of 0.91/0.91.

CONCLUSION

Our results are comparable to studies using monophasic CT by Vorontsov et al., and Chlebus et al. They achieved a higher DSC per case (0.66/0.58) whereas our model was more sensitive (0.66/0.57) and could be used to identify regions of interest which an experienced radiologist could either discard or flag for further inspection.

CLINICAL RELEVANCE/APPLICATION

DCNNs are capable of supporting radiologists by segmenting the liver and identifying potential HCCs automatically. This could enable a more workflow efficient and clinically realistic implementation of LI-RADS.

SSA12-07 Constructing a Platform Based on Deep Learning Model to Mimic the Self-Organization Process of CT Images Order for Automatically Recognizing Human Anatomy

Sunday, Dec. 1 11:45AM - 11:55AM Room: E450A

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PURPOSE

To demonstrate the ability of a deep learning application to automatically identify computed tomography (CT) slice regions by major Human anatomy. This application will be deployed in National Health Insurance of Taiwan (NHI) to classify the around 458 million CT images in 2018.

METHOD AND MATERIALS

954 and 4095 CT series were selected for training and testing correspondingly from NHI and TCIA. The voxel spacing must > 0.6 mm, and series must > 40 slices. Each image was standardized to 128^2 pixels. The AlexNet and ResNet was trained with grey scale images and the 3 color images (bone, liquid and air), correspondingly. The loss function is identical to Ke Yan, and et al. in 2018 and guides slice scores increased by slice order. Linear regression was used to adjust slice score of a series which the r-square < 0.8. The series was split into 4 parts and new slice score was estimated from two of the best parts. Manually annotated lung boundary was used to find the cutoff for measuring sensitivity and specificity.

RESULTS

The AlexNet and ResNet was trained for 2 days. The r-square of linear regression was to measure the linearity between slice score and its order. The amount of series with r-square < 0.8 was reduced from 4.1% to 1.7% in AlexNet and 6.8% to 2.2% in ResNet by using our error correction approach. Fig. 1 depicted the images with similar slice score having similar body part. Based on lung boundary, the score variant of lower boundary was larger than upper boundary. The cutoff was selected based on the highest value of specificity*sensitivity. ResNet had the best prediction performance in training data and validation data (Spec. > 0.94, Sens. > 0.9). AlexNet provided the best prediction performance in NHI validation data (Spec. > 0.91 and Sens. > 0.94). The error correction slightly improved the sensitivity and specificity. The specificity and sensitivity were both larger than 0.9 in NHI validation data by using AlexNet and ResNet.

CONCLUSION

First, the preprocessing process could accelerate training process and reach lower loss by using ResNet and AlexNet is efficient in during the prediction. Fig 2. showed our error correction process sucessfully adjusting slice score to corresponding body part. Since the organ boundary was varied from person to person, this approach is good for large part Identification. Although we found ResNet and error correction could provide good prediction quality with small training data, the model proposed by Ke Yan, and et al. in 2018 trained with large training data is one of the state of art methods.

CLINICAL RELEVANCE/APPLICATION

NHI collected around 458 million medical CT images in 2018. Our application will deploy in one of the largest medical databases in the world. Precisely retrieve the certain images of Human Anatomy could accelerate related application development and reduce the storage usage.

SSA12-08 An Ensemble of Models with a Multi-Threshold Approach to Improve Chest X-Ray Predictions

Sunday, Dec. 1 11:55AM - 12:05PM Room: E450A

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PURPOSE

Our main goal is to assess if deep learning can decrease the list of exams that radiologists need to read, with minimal loss of critical cases. We propose an ensemble with a multi-threshold approach, focusing on the detection of general opacities.

METHOD AND MATERIALS

We use four public datasets: JSTR, OpenI, Shenzen, and Chest-Xray14. After removing some lateral and low quality images, the total amount of images were 117,094 images. We cut the images surrounding the lung mask predicted with a trained U-net, applied a Limited Adaptive Histogram Equalization (CLAHE), resized to 384x384 and normalized based on the mean and standard deviation of images in the ImageNet. Then we developed three models: M1: a binary classifier to detect if an image has some finding or if it is normal M2: a multilabel trained with all images to predict five classes: mass/nodule, edema, atelectasis, alveolar opacity, and non-opacity. M3: a multilabel to predict the same five classes, but without the normal images in the training set. All of them use Inception V4. The ensemble was created using a weighted average in the form: (4*ym1 + 3*ym2 + 3*ym3)/10. We calculate the AUC of ROC Curve and choose two best cut-points using Youden's index.

RESULTS

The mean F1 Score of our model is 0.478 among all classes with an AUC of 0.90 for mass/nodule, 0.86 for edema, 0.85 for atelectasis, 0.86 for alveolar opacity and 0.93 for nonopacity. Analyzing the predictions, we saw that normal images had lower values, the target classes had high values, and in the middle values were images of other pathologies. This justifies the use of two thresholds. With the two thresholds, the general quality of our model is improved. We correctly classified more than 70% of all normal images with just 5% of False Negative Rate (FNR) and the average True Positive Rate (TPR) is 44% in the target classes.

CONCLUSION

The image preprocessing along with the use of ensemble and multi thresholds techniques produced a model with greater certainty and better results.

CLINICAL RELEVANCE/APPLICATION

We can accelerate the radiologist's work by detecting 70% of normal images, decreasing the number of images analyzed and suggesting the pathology according to what was predicted.

SSA12-09 CT Organ Segmentation: Use of Variational Autoencoders to Detect Incorrect Segmentations in a Large Dataset (> 12,000 CT Scans)

Sunday, Dec. 1 12:05PM - 12:15PM Room: E450A

Participants
Veit Sandfort, MD, Bethesda, MD (*Presenter*) Nothing to Disclose
Ke Yan, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Peter Graffy, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
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Ronald M. Summers, MD,PhD, Bethesda, MD (*Abstract Co-Author*) Royalties, iCAD, Inc; Royalties, Koninklijke Philips NV; Royalties, ScanMed, LLC; Royalties, Ping An Insurance Company of China, Ltd; Research support, Ping An Insurance Company of China, Ltd; Research support, NVIDIA Corporation; ; ; ;

PURPOSE

Organ segmentation on CT using neural networks is highly effective but training labels are expensive and insufficient training data impairs performance. Typically, organ segmentation datasets have <400 CTs. Many pathologies and variations are not captured in such small training data. This may explain the gap between theoretical and real-world performance. Images which differ from training data can cause surprisingly severe failures of the algorithms.We hypothesize that failed segmentations can be detected using variationalautoencoders (VAE) without supervision.

METHOD AND MATERIALS

The Segmentation Decathlon data and internal data were used for training (n of 131,41 and 56 for liver, spleen and kidney). CT colonography scans from a large cohort (n=12495) were used for training and testing the autoencoder. A modified 3DUnet was trained on the labeled data. Organ segmentations were performed on 12495 CTs. For each organ a 3D variational autoencoder was trained on all segmentations in an unsupervised fashion. Then, the organ segmentations were passed through the variational autoencoder and the reconstruction error (Dice score) was measured. Organ segmentations (n=2510x3) were visually assessed for significant error by a physician. ROC curves and AUC for detection of failed segmentations were calculated.

RESULTS

The reconstruction errors of the autoencoder were 0.87, 0.76 and 0.81, for liver, spleen and kidney, respectively. Of the reviewed segmentations, 1.6-4.9% showed significant errors. The variational autoencoder reconstruction error was highly effective in detecting problematic segmentations, evidenced by AUCs of 0.94, 0.87 and 0.9 for liver, spleen and kidney (for ROC curve and an example see figure, note that the erroneous area [arrow] is not present in the autoencoder output).

CONCLUSION

The use of deep learning based segmentation in medical imaging has been increasing rapidly. These algorithms are powerful but not very robust in regard to cases with unexpected characteristics and this may cause catastrophic failure of the algorithm.We show that our method can detect failed segmentations effectively (AUCs 0.87-0.94).This is useful for continuous quality monitoring and for active learning.

CLINICAL RELEVANCE/APPLICATION

Deep learning methods are vulnerable to failure when confronted with unexpected cases. This is a critical issue for clinical uses. Our method has the potential to detect such failure without supervision.

Printed on: 10/29/20

SSA13

Science Session with Keynote: Molecular Imaging (Neuroimaging)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S503AB

MR MI NR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Peter Herscovitch, MD, Bethesda, MD (*Moderator*) Nothing to Disclose
Karina Mosci, MD, Brasilia, Brazil (*Moderator*) Nothing to Disclose

Sub-Events

SSA13-01 Molecular Imaging Keynote Speaker: Artificial Intelligence in Neuroimaging

Sunday, Dec. 1 10:45AM - 11:05AM Room: S503AB

Participants
Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Presenter*) Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd;

SSA13-03 Clinical-Radiological Features of Methotrexate Induced Sub-Acute Leukoencephalopathy in Patients with Acute Lymphoblastic Leukemia: "Panda Eye Sign" on DW-MR Imaging

Sunday, Dec. 1 11:05AM - 11:15AM Room: S503AB

Participants
Abhishek Mahajan, MBBS,MD, Mumbai, India (*Presenter*) Nothing to Disclose
Hasmukh Jain, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose
Tanvi Vaidya, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose
Santhosh K. G V, MD , Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Anurag Gupta, MD, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Subacute leukoencephalopathy in ALL is a rare complication after high dose methotrexate (HDMTX) administration and recognizing this self-remitting entity has important therapeutic implications. We did a retrospective study to evaluate the role of MR imaging in diagnosing this entity and asses the incremental value of Qualitative and Quantitative diffusion weighted MR (DW-MRI).

METHOD AND MATERIALS

A retrospective review of database was performed for adolescent and adult ALL (Aged>14 years) patients who were treated at our center with the modified Berlin-Frankfurt-Münster (BFM)-90 protocol (BFM-90 protocol). 438 patients were screened from year 2014-2015, of which 239 patients were eligible for the BFM-90 protocol. All patients were treated with high dose methotrexate (>1g/m2) and presented with new onset of neurological disturbances were identified. Eleven patients of ALL aged >14 years who developed acute onset of neurological symptoms within two weeks (14 days) after administration of high dose methotrexate and underwent CT and MR imaging with diffusion weighted MR imaging (with 48 hours of presentation) were analyzed. The mean mADC values (10-3 cm2/sec) were calculated on a voxel-by-voxel basis using ADW 4.4 software provided with the MR imaging unit.

RESULTS

Eleven patients were identified from a cohort of 239 patients (~5%). They presented with focal neurological deficits within ~14 days after HDMTX that resolved completely with conservative measures. The CT scans were normal in all these patients. A consistent finding seen in all these cases was the occurrence of restricted diffusion in the region of the centrum semiovale on DW-MRI. On diffusion maps, symmetrical areas of hyperintensity resembled 'Panda eyes' and mADC cut-off of our series was 0.000453 x 10-3 +/- 0.000120 cm2/sec.

CONCLUSION

CT brain and Conventional MR imaging have no significant role to play in diagnosing this entity however restricted in the centrum semiovale is a consistent imaging finding and the "panda eye sign" as seen on DW imaging can be considered diagnostic for methotrexate induced subacute leukoencephalopathy and this sign can help in timely establishment of the diagnosis and appropriate management.

CLINICAL RELEVANCE/APPLICATION

The literature is limited on incremental of colored diffusion maps and mean apparent diffusion co-efficient (mADC) values and their role in diagnosing MIN.

SSA13-04 Biotin-Conjugated Upconversion Nanoparticles for Metabolic MR Imaging of Invasive Margin of Glioma

Sunday, Dec. 1 11:15AM - 11:25AM Room: S503AB

Participants
Hua Zhang, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To prepare one stable biotinylated/polyethylene glycolylated upconversion nanoprobes (biotin/PEG-UCNPs) to study the expression level of biotin receptor in GL261 glioma and its feasibility for detection invasive margin of glioma

METHOD AND MATERIALS

Hydrophobic multifunctional upconversion nanoparticles (UCNPs) were synthesized by solvothermal method. TEM, XRD ,fluorolog-3 modular fluorescence spectrometer and other instruments were used to analyze the surface features such as uniformity and dispersion of nanoprobes. Cell counting kit-8 (CCK-8) analyzed the effect of bion-UCNPs on the activity of RAW264.7 and BCECs. CLSM was used to observe the endocytosis efficiency of GL261 glioma cells for biotinylated and non-biotinylated nanoprobes, then the distribution of nanoprobes in glioma tissues compared with pathology. GE Discovery 3.0T MR analyzed the relaxation rate of biotinylated nanoprobes and the relative signal intensity (rSI) of biotinylated nanoprobes in gliomas at different time points. HE staining of cortical, striatum, hippocampal and hematological parameters of normal C57BL/6 mice were evaluated the potential toxicity of biotinylated nanoprobes to living organisms.

RESULTS

Biotinylated nanoprobes with similar particle size (particle size of about 25 nm) possessed good dispersibility, low toxicity and single-band UCL spectrum centered at 660 nm. The relaxation rate reached 6.124 mM-1S-1. Under CLSM, the glioma cells significantly endocytosed biotinylated nanoprobes rather than the non-biotinylated nanoprobes. After biotin receptor presaturation, the glioma cell endocytosis was significantly reduced. T1 signal generated by the biotinylated nanoprobes in the glioma region could still be observed in 24 hours, and the tumor developing area was expanding. The body boundary of biotinylated nanoprobes well corresponded to the HE-stained glioma border, but the tumor cells were scattered around the boundary. No obvious adverse reactions were observed in the cortical, striatum, hippocampal.

CONCLUSION

GL261 gliomas highly express biotin receptors. Biotinylated UCNPs are able to efficiently target glioma via biotin receptors, and show a significant contrast effect on the edge of glioma invasion.

CLINICAL RELEVANCE/APPLICATION

(dealing with invasive margin of glioma) Biotin-UCNPs can explicitly demonstrate the glioma cells scattered around the boundary via biotin receptor

SSA13-05 Dynamic Contrast-Enhanced Magnetic Resonance Imaging for Monitoring the Anti-angiogenesis Efficacy in a C6 Glioma Rat Model

Sunday, Dec. 1 11:25AM - 11:35AM Room: S503AB

Participants
Weishu Hou, Hefei, China (*Presenter*) Nothing to Disclose
Xiaohu Li, MD, Hefei, China (*Abstract Co-Author*) Nothing to Disclose
Hongli Pan, Hefei, China (*Abstract Co-Author*) Nothing to Disclose
Man Xu, Hefei, China (*Abstract Co-Author*) Nothing to Disclose
Yinfeng Qian, Hefei, China (*Abstract Co-Author*) Nothing to Disclose
Yongqiang Yu, MD, Hefei, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To observe the changes of dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) parameters in monitoring the early effects of antiangiogenic therapy in a C6 glioma rat model.

METHOD AND MATERIALS

Twenty-six rats were used to establish a C6 glioma model and were randomly divided into a treated group (n = 13) and a control group (n = 13). Rats in the treated group were administered with bevacizumab (Bev) for 7 days, while rats in the control group were administered with vehicle at the same dose. Conventional MRI and DCE-MRI scans were obtained, respectively, on days 0, 1, 3, 5, and 7 after treatment; tumor volume and MRI parameters were dynamically observed. Hematoxylin and eosin (HE) and immunohistochemical (IHC) examination including MVD and proliferating cell nuclear antigen (PCNA) were performed on day 7. One-way ANOVA was used to compare intra-group differences in each group and t-test was used to compare inter-group differences of MRI parameters between the two groups. Correlations between MRI quantitative parameters and IHC scores were analyzed.

RESULTS

The tumor volume and relative change of tumor volume in the treated group were significantly lower than that of control group on day 7 after treatment with Bev. Ktrans and Kep decreased in the treated group while they increased in the control group; Ve increased in the treated group while it decreased in the control group. A significant difference in MRI parameters between the two groups was observed on days 5 and 7 after treatment. Ktrans and Kep showed positive correlations with MVD, while Ve showed negative correlation with PCNA.

CONCLUSION

DCE-MRI dynamically and accurately assessed the early effects of anti-angiogenic therapy against tumors and may be used as a

therapeutic strategy.

CLINICAL RELEVANCE/APPLICATION

DCE-MRI can assessed effects of anti-angiogenic therapy of glioma.

SSA13-06 The Correlation Analysis of MR Diffusion Tensor Imaging: MR Perfusion Weighted Imaging and Fluorine-18-deoxyglucose Positron Emission Tomography in Patients with Malignant Brain Tumors

Sunday, Dec. 1 11:35AM - 11:45AM Room: S503AB

Participants
Xiang Liu, MD, Rochester, NY (*Presenter*) Nothing to Disclose
Wei Tian, MD,PhD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
Henry Z. Wang, MD, PhD, Pittsford, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

MR diffusion tensor imaging (DTI), MR dynamic susceptibility contrast perfusion weighted imaging (DSC-PWI), and fluorine-18-deoxyglucose (FDG) positron emission tomography (PET) are major clinical advanced imaging techniques for malignant brain tumors. The purpose of this study is to evaluate the correlation between MR DTI and PWI parameters and FDG-PET changes in patients with malignant brain tumors.

METHOD AND MATERIALS

75 paired MR DTI, DSC-PWI and FDG-PET examinations in 62 patients with malignant brain tumors, including high grade gliomas, brain metastases and cerebral lymphomas, were enrolled in this study. The interval between MR (DTI and DSC-PWI) and FDG-PET examinations ranged from 0 to 13 days in 66 paired MR DSC-PWI and FDG-PET examinations, another 6 paired stable post-surgical scans were acquired within 28 days. The ADC, FA and rCBV maximal rCBV ratio without and with contrast leakage correction were measured using FDA-approved GE BrainStat and NordicICE programs. The tumor versus normal tissue count ratio (TNR) in the "hot" ROIs were calculated for comparison. The correlations between minimal ADC, maximal FA and maximal rCBV ratio of rCBV without and with contrast leakage correction and TNR were evaluated with Spearman Rank correlation analysis.

RESULTS

There was no significant correlation between ADC and FA and TNR derived from FDG-PET ($p>0.05$). The mean maximal rCBV ratio of rCBV with contrast leakage correction (1.88±1.41) were higher than rCBV without contrast leakage correction (1.19 ± 0.77, $p<0.05$). The rCBV with contrast leakage correction has better correlation with FDG-PET-TNR than rCBV without contrast leakage correction, $p<0.001$. Figure 1.

CONCLUSION

The rCBV with contrast leakage correction shows better correlation with FDG-PET-TNR. Combination of MR DTI, MR-DSC-PWI and FDG-PET parameters could provide comprehensive information of tumor microstructure, hemodynamic and metabolic abnormality.

CLINICAL RELEVANCE/APPLICATION

Combination of MR DTI, MR-DSC-PWI and FDG-PET parameters could provide comprehensive information of tumor microstructure, hemodynamic and metabolic abnormality.

SSA13-07 Radiomic Classification of Tumors Based on Tumor-Associated Macrophage Burden

Sunday, Dec. 1 11:45AM - 11:55AM Room: S503AB

Participants
Zbigniew Starosolski, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Alzeca Biosciences, LLC
Amy Courtney, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Igor Stupin, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
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Leonid Metelitsa, MD,PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Ketan B. Ghaghada, PhD, Houston, TX (*Presenter*) Research Consultant, Alzeca Biosciences, LLC

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PURPOSE

A high burden of tumor-associated macrophages (TAMs) has been correlated with an aggressive disease phenotype and poor prognosis in several cancer types. Non-invasive imaging techniques for stratifying tumors based on TAM burden could help in treatment planning and monitoring response to immune-directed therapies. In this pre-clinical study, we investigated a radiomics approach for the stratification of solid tumors based on TAM burden.

METHOD AND MATERIALS

Studies were performed in transgenic mouse models of neuroblastoma (NB) with low and high TAM burden. The SV40-induced NB mouse model, which develops spontaneous adrenal tumors (NB-Tag), was used as a model of low TAM burden (n=5). Knock-out NB-Tag mouse models lacking Ja18 (*Ja18-/-*) (n=6) or CD1d (*CD1d-/-*) (n=4) were used as models of high TAM burden. The high TAM burden in knock-out models was confirmed by flow cytometry. Contrast-enhanced CT (CECT) imaging was performed four days after administration of a liposomal-iodine (Lip-I) nanoparticle contrast agent. Tumors were segmented in CT images and quantitative radiomic analysis was performed using an open-source software (PyRadiomics). A Wilcoxon statistical test was used for

selection of radiomic features.

RESULTS

Average tumor CT signal did not differ significantly between tumors in low and high TAM burden groups. However, radiomic analysis identified 49 features that differentiated ($p<0.05$) low TAM tumors from high TAM *CD1d-/-* tumors, and 31 features that differentiated ($p<0.05$) low TAM tumors from high TAM *Ja18-/-* tumors. Subsequently, tumors in two high TAM burden groups (*CD1d-/-* and *Ja18-/-*) were pooled together and compared against tumors in low TAM NB-Tag group to determine if radiomic analysis differentiated tumors based on TAM burden but independent of knock out model. Analysis yielded 26 features that separated ($p<0.05$) low TAM tumors from high TAM tumors. Radiomic features based on first order statistics and gray level size zone matrix represented the dominant set of features that enabled separation of tumors based on TAM burden, suggesting markedly different tumor texture in CECT images in low and high TAM burden tumors.

CONCLUSION

Radiomic analysis identified texture-based features that stratified tumors based on macrophage burden.

CLINICAL RELEVANCE/APPLICATION

Radiomics may enable surveillance of immune cell burden in solid tumors.

SSA13-08 Long-Duration MRI Imaging of Single-Cell In-Vivo and In-Vitro via Magnetic Vortex Nanorings

Sunday, Dec. 1 11:55AM - 12:05PM Room: S503AB

Participants
Ran Sun, Chengdu, China (*Presenter*) Nothing to Disclose
Liu Hanrui, Chengdu , China (*Abstract Co-Author*) Nothing to Disclose
Yingkun Guo, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Haiming Fan, Xian, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To develop an ultra-high sensitive MRI contrast agent for long-term in vivo and in vitro single-cell tracking, which can escape early lysosomes into cytoplasm, especially under the disturbance of alternating magnetic field.

METHOD AND MATERIALS

Bone marrow mesenchymal stem cells (BMSCs) of SD rats were labeled with 50 μg/ml Fe ferrimagnetism vortex magnetic nanorings (FVIOs). In vitro MRI was performed on three groups with number of 1, 5 and 10 labeled BMSCS. For in vivo imaging, 10, 100 and 1000 labeled BMSCs were injected into SD rats' brain via stereotaxis technology and scanned at 7T SWI (susceptibility weighted imaging). After 1h of co-culture of BMSCs and nanorings, alternating magnetic field (AMF) were added for minutes of continuous interference. Another 23h co-culture was performed, then BMSCs were stained and lysosomal escape effect was detected under confocal microscope. GFP-transfected BMSCs were co-cultured with FVIOs by the same method and transplanted into the striatum of SD rats according to the number of cells for long-term magnetic resonance detection.

RESULTS

From the in vitro 7T MRI images, the signals of single FVIOs labeled BMSCs could be clearly detected compared with contract groups. And the in vivo results shows that at least 10 transplanted BMSCs in SD rats' brain could be detected by strong MRI signal. Confocal results also shows that AFM disturbance could successfully facilitate FVIOs to escape from lysosomes into cytoplasm in 10 minutes at early period of co-culture of BMSCs and FVIOs . The same FVIOs labeled GFP-MSCs were transplanted into rats' brain and also could be detected for more than 8 weeks at 7T MRI. Immunofluorescence histochemical analysis showed that some transplanted cells were still alive and corresponding to the signal position detected by MRI.

CONCLUSION

The FVIOs we reported had ultra-high MRI sensitivity to accurately track single cell both in vitro and in vivo, as well as succeed in escaping the lysosome under the interference of alternating magnetic field.

CLINICAL RELEVANCE/APPLICATION

Ferrimagnetism vortex magnetic nanorings has a broad prospect of clinical application because of its low toxicity, low dose and high sensitivity. Its high safety and efficiency surpasses the contrast agents currently used in clinic. In addition, it provides a robust tracer technology support in the further treatment of stem cells and promote stem cell treatment to the clinic faster and better.

SSA13-09 Quantification of Blood Spinal Cord Barrier Opening After Application of Magnetic Resonance Guided Focused Ultrasound

Sunday, Dec. 1 12:05PM - 12:15PM Room: S503AB

Awards
Trainee Research Prize - Medical Student

Participants
Chloe G. Cross, BSC, Salt Lake City, UT (*Presenter*) Nothing to Disclose
Allison Payne, PhD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Gregory W. Hawryluk, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Riley Haag-Roeger, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Rahul Cheeniyil, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
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Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Abstract Co-Author*) Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd;

Donna J. Cross, PhD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To develop observer-independent MRI quantification of blood spinal cord barrier (BSCB) permeability after magnetic resonance guided focused ultrasound (MRgFUS) in spinal cord injury (SCI).

METHOD AND MATERIALS

Rats (n=21) underwent T8-T10 laminectomy and extradural compression of the spinal cord (23g weighted aneurysm-type clip, 1 min). High-resolution T1w MR images (3T Siemens, 3D VIBE, FOV=162 mm162 mm×45 mm, res=0.4 mm×0.4mm×0.8 mm interpolated to 0.2 mm×0.2 mm×0.4 mm, TR/TE=6.21/2.94 ms, FA=10°) were obtained pre-MRgFUS without contrast, pre-MRgFUS half-dose contrast, and post-MRgFUS full-dose contrast (Gadoteridol, 0.25 mL/kg, 0.1 mL saline). Rats (n=11) were placed on a MRgFUS system (256-element phased-array transducer, f=940 kHz, focal depth=10cm, intensity FWHM=1.8×2.5×10.9 mm3), injected Optison microbubbles (0.2 mL/kg, 0.1 mL saline) and received 3 doses in 4 locations, 2 mm apart (25 ms bursts, 1 Hz pulses for 3 min, 1.0-2.1 MPa peak pressure). Shams (n=10) received equivalent procedures with no sonications. Spinal cords were segmented manually or semi-automatically using the Spinal Cord Toolbox. SCI rats post-MRgFUS average ROI intensity were normalized to pre-MRgFUS half-contrast. Non-injured rats (n=3) were administered Evans Blue post-MRgFUS and spinals cords were sectioned into 5 mm x 7 samples. Absorbance was measured by spectrophotometry at 655 nm per mg tissue and correlated to post-MRgFUS ROIs normalized to pre-MRgFUS.

RESULTS

Semi-automatic segmentation reduced time by 95% and showed no difference to the manual method (Pearson = 0.92, p=.00001, n=71 regions). Evans Blue absorbance correlated to image intensity in MRgFUS and control ROI (Pearson = 0.82, p=.02, n=6). Increase in signal intensity in MRgFUS ROI relative to control was seen in all SCI MRgFUS rats (10.65±12.4%, range: 0.96-43.9%, n=11). SCI sham MRgFUS revealed no change (0.63±0.52%, range: 0.15-1.63%, n=10). This result was significant between both groups (p=.003).

CONCLUSION

Semi-automatic segmentation of the rat spinal cord was successful. Evans Blue absorbance was correlated to image intensity values in non-injured rats. Quantitative methods are sensitive for detection of BSCB opening induced by MRgFUS in the SCI animal model.

CLINICAL RELEVANCE/APPLICATION

Most potential therapeutics for SCI require invasive (surgery) or semi-invasive (intrathecal) delivery. The use of MRgFUS to open the BSCB and deliver therapeutics will facilitate recovery from SCI.

Printed on: 10/29/20

SSA14

Musculoskeletal (Bone Marrow and Neoplasms)

Sunday, Dec. 1 10:45AM - 12:15PM Room: E450B

CT MK

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Karen C. Chen, MD, Providence, RI (*Moderator*) Nothing to Disclose
Ali Guermazi, MD,PhD, West Roxbury, MA (*Moderator*) Shareholder, Boston Imaging Core Lab, LLC; Research Consultant, Merck KGaA; Research Consultant, Roche, Inc; Research Consultant, TissueGene, Inc; Research Consultant, Galapagos, Inc; Research Consultant, AstraZeneca PLC; Research Consultant, Pfizer Inc

Sub-Events

SSA14-01 Diagnostic Accuracy of Dual-Layer Detector CT Using Calcium-Suppressed Images for the Detection of Bone Marrow Edema in Wrist

Sunday, Dec. 1 10:45AM - 10:55AM Room: E450B

Participants
Ji-Eun Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hye Jin Yoo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee-Dong Chae, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ja-Young Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sung Hwan Hong, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Hee Kang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyunjung Yeoh, BMedSc, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the performance of calcium suppressed images (CaSupp) obtained by dual-layer detector computed tomography (DLCT) for the detection of bone marrow edema (BME) in patients with wrist pain.

METHOD AND MATERIALS

We retrospectively analyzed 49 patients with wrist pain (44 distal radius fractures, 2 carpal bone fractures, 2 scaphoid nonunion advance collapses, 1 Kienböck disease), who underwent both DLCT and MRI. Two blinded and independent readers evaluated CaSupp images for evaluating BME by using color-coded maps. Using MRI images as the reference standard, the sensitivity and specificity of CaSupp images were analyzed for detecting BME of radius, ulna, and carpal bones.

RESULTS

On MRI, 44 distal radius and 30 distal ulna fractures were found. In detecting BME of radius and ulna, two readers showed 100% of agreement. When CaSupp images were compared with MRI images, sensitivity and specificity for detecting BME were both 100% for radius, and 88% and 87.5% for ulna, respectively. For carpal bone, BME was found in 8 of 44 radius fractures and 5 of patients with only carpal bone abnormalities on MRI. Those carpal bone BMEs were detected on CaSupp images with following diagnostic accuracy: sensitivity, 92.8% for reader 1 and 64.2% for reader 2; specificity, 88.5% in both readers. For detection of carpal bone BME, two readers showed moderate agreement (agreement 75.5%, kappa value 0.43).

CONCLUSION

CaSupp images reconstructed from DLCT enabled detection of BME in fractured distal radius and ulna with substantially high diagnostic accuracy when compared to MRI images. However, CaSupp demonstrated limited performance in visualization of BME of carpal bone pathologies.

CLINICAL RELEVANCE/APPLICATION

CaSupp images showed similar performance in visualization and detection of BME in wrist, including incomplete fracture compared with MRI. CaSupp images is expected to be a promising technique to demonstrate BME in wrist.

SSA14-02 3D UTE Bicomponent T2* Analysis of Cortical Bone using a Novel Soft-Hard Composite Excitation Pulse

Sunday, Dec. 1 10:55AM - 11:05AM Room: E450B

Participants
Liang Li, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
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Eric Y. Chang, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose

Jiang Du, PhD, San Diego , CA (*Abstract Co-Author*) Nothing to Disclose
Yajun Ma, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
Hoda Shirazian, MD, San Diego, CA (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate 3D UTE bi-component T2* analysis of cortical bone ex vivo and in vivo using a novel soft-hard composite excitation pulse on a 3T scanner.

METHOD AND MATERIALS

UTE bi-component T2* analysis has been used to quantify T2*s and relative fractions of bound water (BW) and pore water (PW) in cortical bone. However, chemical shift artifact and fat-water oscillation may significantly affect the quantification accuracy. Here a 3D UTE Cones sequence with a soft-hard composite pulse was developed on a 3T GE MR750 scanner, and compared with Cones imaging with a short rectangular pulse excitation and a conventional FatSat module, respectively. The sequences were applied to bovine bone samples (n?=?2) and tibial midshafts of volunteers (n?=?6). Bi-component T2* analyses were performed and results including T2* and fractions were compared.

RESULTS

Comparable fat suppression was achieved with the soft-hard composite pulse and the FatSat module. More robust bi-component T2* fitting was achieved with 3D UTE Cones imaging with the soft-hard composite pulse, which outperformed the short rectangular pulse with greatly reduced fat water oscillation and chemical shift artifacts especially for cortical bone imaging, as shown in Figure 1. The conventional FatSat module suppressed fat signal and related fat-water oscillation, however, the BW fraction was greatly reduced due to direct saturation. For bovine bone samples the mean BW fraction was 75.73±1.58% for the composite pulse and 52.9±27.8% for the hard pulse. For human tibial midshafts the BW fraction was 71.3±3.0% for the composite pulse and 34.7±1157.1% for the hard pulse. The short T2 signals of cortical bone in the UTE-Cones images with the soft-hard pulse excitation were much better preserved than those in the FatSat UTE-Cones images. Meanwhile, fat signals were greatly suppressed by the soft-hard composite pulse, leading to much improved T2* bi-component analysis of bound and pore water fractions.

CONCLUSION

The 3D UTE Cones sequence with a soft-hard composite pulse allows more robust volumetric mapping of bound and pore water T2*s and relative fractions in cortical bone.

CLINICAL RELEVANCE/APPLICATION

The 3D UTE Cones sequence with a soft-hard composite pulse allows more robust volumetric mapping of bound and pore water T2*s and relative fractions in cortical bone.

SSA14-03 Differentiation of Myelodysplastic Syndrome from Aplastic Anemia Using Conventional Multiparametric MRI and Machine Learning

Sunday, Dec. 1 11:05AM - 11:15AM Room: E450B

Participants
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PURPOSE

Distinguishing myelodysplastic syndromes (MDS) from aplastic anemia (AA) can be challenging because patients with these diseases share many clinical features, such as hypocellular bone marrow (BM). This research aimed to build an MRI-based predictive model to differentiate between these entities using a machine learning algorithm.

METHOD AND MATERIALS

Patients with histologically confirmed MDS (n=24) or AA (n=29) were retrospectively investigated. First, we used three machine-learning approaches including a logistic regression model for the classification task to differentiate the entities. We included mean ADC, indices calculated from the ADC histogram, perfusion indices, and fat fraction from ROIs within the BM of L1-L3, and whole blood test data, including the reticulocyte percentage, as inputs in the model. We used 10-fold cross-validation to prevent overfitting. Next, we compiled datasets of the lumbar MR images of T1WI. We fine-tuned a convolutional neural network (CNN) on our training dataset. The CNN with standard cross-entropy loss function and the Adam optimizer with an initial learning rate of 0.001 provided automated prediction of the diagnosis. Third, the diagnostic performances of a radiology fellow, experienced musculoskeletal radiologist, and senior hematologist with specific expertise in pancytopenia were calculated.

RESULTS

Of the 53 MRIs tested, the algorithm by conventional multiparametric MRI predicted diagnosis correctly by the logistic regression model with the highest accuracies of 77.4% for MDS and 77.4% for AA with a combination of features of age, fat fraction, and platelet count. The accuracy achieved by the CNN on random sampling with 90% of training set size and 50 iterations was 84.0% (Figure). In general, the misclassified results were caused by signal intensity and heterogeneity within the BM. The AUC (95%CI) for the CNN was 0.810. The fellow, radiologist, and hematologist showed 60%, 66%, and 66% accuracy, respectively.

CONCLUSION

The CNN provided better differentiation of MDS from AA than conventional multiparametric MRI or visual inspection by human observers. Age, fat fraction of lumbar BM, and platelet count in whole blood proved useful for differentiation of these two entities.

CLINICAL RELEVANCE/APPLICATION

A machine learning algorithm proved effective for differentiating MDS from AA. Machine learning may help to improve prognosis through early and appropriate treatment.

SSA14-04 Quantitative Assessment of Bone Marrow Adipose Tissue after Roux-en-Y Gastric Bypass Surgery in Postmenopausal Women

Sunday, Dec. 1 11:15AM - 11:25AM Room: E450B

Participants
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PURPOSE

To determine the effect of laparoscopic Roux-en-Y gastric bypass surgery (RYGB) on quantitative assessment of bone marrow adipose tissue (BMAT) and volumetric bone mineral density (vBMD), in postmenopausal women. Bariatric surgery rates are rising as a consequence of the increase in obesity and its associated diseases. RYGB effectively reduces body weight and improves metabolic health, but is also associated with increased fracture risk. BMAT could be a possible mediator of the increased fracture risk following bariatric surgery, since high BMAT is associated with increased fracture risk.

METHOD AND MATERIALS

The study was approved by the local medical ethics committee. We included 17 postmenopausal, non-diabetic obese women, scheduled for laparoscopic RYGB. We determined bone marrow fat signal fraction (BMAT) of L3-L5, measured by SE-Dixon Quantitative Chemical Shift Imaging and vBMD of L3-4, measured by QCT, before surgery and 3 and 12 months after surgery. Data were analyzed by linear mixed model.

RESULTS

BMAT was negatively associated with vBMD at baseline (R2=0.41 p=0.005). Body weight decreased after surgery from 106±15 [baseline] to 91±13 [3 months] and 74±10 kg [12 months, p<0.001]. BMAT decreased after surgery from 52±8% [baseline] to 50±8% [3 months] and 46±7% [12 months, p<0.001]. vBMD decreased after surgery from 104±27 [baseline] to 95±21 [3 months, p=0.001] and 98±26 mg/cm3 [12 months, p=0.080]. Calcium and vitamin D did not change after surgery.

CONCLUSION

We show a decrease in BMAT 12 months after RYGB and a decrease in vBMD 3 months after RYGB. As high BMAT is associated with increased risk of fractures, independently of BMD in some studies, quantitative assessment of BMAT could potentially be interesting as a new imaging biomarker for assessment for bone quality following RYGB.

CLINICAL RELEVANCE/APPLICATION

Quantitative assessment of bone marrow adipose tissue by quantitative chemical shift imaging has potential as an imaging biomarker for bone quality after RYGB surgery.

SSA14-05 Improved Detection of Benign and Malignant Rib Lesions in the Routine CT Work-Up of Oncological Patients Using Automated Unfolded Rib Image Post-Processing

Sunday, Dec. 1 11:25AM - 11:35AM Room: E450B

Participants
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PURPOSE

To evaluate the performance of automated CT post-processing software generating unfolded rib images for improved detection of both benign and malignant rib lesions during routine diagnostic work-up of oncological patients.

METHOD AND MATERIALS

1008 in- and outpatients (63.66 ±14.25 years; range 18.67 to 95.67 years; 405 females and 603 males) undergoing chest-CT between 07/2018-1/2019 at our own institution were retrospectively evaluated. Patients underwent chest-CT alone or as part of a whole-body CT staging/restaging. The CT-protocol consisted of 120kV, 100 mAs, matrix 512x512, collimation 0.6mm, reconstructed section thickness 3mm and 1mm using a soft tissue spatial resolution kernel (I30f) and a sharp kernel (B70f). Both transversal image data sets were used for "conventional" diagnosis including coronal reformates with 3mm slice thickness. 1mm slice thickness image data sets of all patients were additionally directed from the scanner to a computational server where they were automated post-processed to 3D unfolded ribs. The "unfolding" of the rib using the centreline as an axis allows a synchronous display and rotation of all ribs from 0 to 360°. The standard of reference was 18F-FDG-PET, Ga68-DOMITATE-PET/CT, bone scan or imaging follow-up (>6mo).

RESULTS

From a total of 1008 evaluated patients 763 (73.02%) were hematooncologic patients. A total of 104 rib lesions were found by

transversal CT-image reading whereas the unfolded rib image reading detected 305 lesions. 89 were classified malignant and 202 were classified benign. Detection of malignant rib lesions proved significant both for <1cm diameter (p<0.02) and >1cm diameter (p<0.007). The sensitivity, specificity, PPV and NPV for detection of malignant rib lesions was 97.7%/98.5%/96.6%/99% for unfolding ribs and 76.4%/100/92.7%/90.5% for conventional (transversal) image reading. Detection of sclerotic rib lesions and lesions >1cm in diameter was significantly better (p<0.01) for the unfolding rib algorithm.

CONCLUSION

The 'unfolded rib' reformates are significantly superior for rib lesion detection compared to conventional transversal CT-scan reading and should be therefore used in all patients in particular in those with oncologic background.

CLINICAL RELEVANCE/APPLICATION

The 'unfolded rib' reformates are significantly superior for rib lesion detection and should be therefore used in all patients in particular in those with oncologic background.

SSA14-06 Convolutional Neural Networks versus Expert Radiologist Accuracy in Differentiating Benign and Malignant Soft Tissue Neoplasms

Sunday, Dec. 1 11:35AM - 11:45AM Room: E450B

Participants
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PURPOSE

To evaluate the accuracy of convolutional neural networks (CNNs) in differentiating pathologically-proven benign from malignant soft tissue musculoskeletal neoplasms as compared to that of experienced musculoskeletal radiologists.

METHOD AND MATERIALS

One hundred patients with histologically-confirmed soft tissue tumors were identified from the institutional medical record. T1W, fat-suppressed T2W (fsT2W), fat-suppressed T1W pre- (T1-Pre) and post-contrast (T1-Post) MR images were used to train four CNNs, each using data from one sequence. A fifth CNN was created using all imaging sequences in combination. For image pre-processing, volumetric regions of interest (ROIs) corresponding to tumor boundaries were segmented on Horos software. PyOsiriX was used to export images and ROI masks for later analyses. Patches of 201 x 201 pixels were generated in each tumor ROI. Five-hundred patches per MR sequence were selected from each of the 100 patients, with 60 patients chosen for testing, 10 for validation, and 30 (50% benign) for independent testing. The training and validation studies were used to optimize an Inception V4 CNN with 201 layers, constructed in Tensorflow. Tumors in the testing set were classified as benign or malignant using the CNN models. Two blinded MSK radiologists also classified the same testing cases as benign or malignant. Accuracy of the CNN models was compared to that of the radiologists. Statistical tests included Area Under the Curve (AUC) and Fisher's Exact Test.

RESULTS

Each radiologist attained an accuracy of 0.66. The five CNNs achieved the following accuracies and AUCs, respectively: 0.69, 0.70 (T1W); 0.74, 0.80 (T1-Pre) 0.78, 0.76 (T1-Post); 0.70, 0.70 (fsT2W); 0.80, 0.82 (combined CNN). No significant difference was found between the accuracy of the combined CNN model and either radiologist (p>0.05). False positive rate for malignancy was significantly higher in both radiologists as compared to the combined CNN (p<0.05).

CONCLUSION

CNNs differentiate benign versus malignant soft tissue neoplasms with moderate accuracy using individual MR sequences and good accuracy using the full conventional MR imaging protocol. Overall accuracy is similar to expert radiologist interpretation.

CLINICAL RELEVANCE/APPLICATION

Machine learning approaches could serve as a valuable adjunct to clinical practice for physicians and non-musculoskeletal fellowship trained radiologists.

SSA14-07 Qualitative Evaluation of MRI Features of Lipoma and Atypical Lipomatous Tumors: Results from a Multi-Center Study

Sunday, Dec. 1 11:45AM - 11:55AM Room: E450B

Participants
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PURPOSE

The purpose of this study was to: (a) evaluate MRI qualitative features that differentiate benign lipomas (BL) from atypical lipomatous tumors (ALT); (b) assess radiologic confidence in diagnosing BL versus ALT.

METHOD AND MATERIALS

This retrospective multicenter study recruited a total of 247 (136 females) subjects (median age:59 years; range:23-92). All subjects underwent presurgical contrast-enhanced MRI. MRI was centrally read by a board-certified radiologist for site, depth (superficial/deep), architectural complexity, level of fat suppression, enhancement and septa. Significant features in univariate analysis were further studied using a logistic regression model with 1000-samples bootstrapped 95% confidence interval (CI). The radiologist's impression was recorded as BL or ALT. A 4-point scale (1-4) reflecting the diagnostic confidence was also used, with 4 being the highest level of confidence. Histopathology (including MDM2) was used as the diagnostic reference standard.

RESULTS

71 ALTs were pathologically verified. Subjects with ALTs were significantly older (61±13 vs. 56±12yr) and presented with pain or discomfort. Multiple features were significantly associated with the pathologic diagnosis in univariate analysis, but in multivariate analysis only large tumor size (OR=1.08, 95%CI:1.01-1.16), deep location (OR=4.31, 95%CI:1.02-18.33), proximal lower limb location (OR=5.97, 95%CI:2.12-16.82), incomplete fat saturation (OR=3.28, 95%CI:1.14-9.49), and increased architectural complexity (OR=9.44, 95%CI:3.51-25.44) were independent predictors of ALT. Overall radiologist impression was 80% sensitive (95%CI:69-89%) and 79% specific (95%CI:72-85%). 8/97 cases with a confidence score of 4 and 9/64 cases with a confidence score of 3were misdiagnosed. Radiologist confidence score inversely correlated with the proportion of misdiagnosis ($p<0.05$).

CONCLUSION

The MRI features tumor size, depth, location, fat saturation and architectural complexity were independent predictors of ALT. Though these features may help in the differentiation of lipomatous lesions, several cases were misdiagnosed even when the radiologist expressed a high level of diagnostic confidence.

CLINICAL RELEVANCE/APPLICATION

MRI features can help differentiating lipomatous lesions, however, even when the radiologist's confidence level is high, several cases were misdiagnosed. Clinician should be aware of the limitations of MRI features.

SSA14-08 CT Radiomics in Alveolar Soft Part Sarcoma Response to Novel Immunotherapy Regimen

Sunday, Dec. 1 11:55AM - 12:05PM Room: E450B

Participants
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PURPOSE

Axitinib/pembrolizumab has recently shown superior efficacy compared to historical controls in the treatment of alveolar soft part sarcoma (ASPS). We aimed to evaluate CT texture analysis of ASPS lesions treated with this novel immunotherapy regimen.

METHOD AND MATERIALS

This IRB-approved study included 28 lesions in 10 subjects with ASPS enrolled in a prospective phase 2 clinical trial. Patients received axitinib and pembrolizumab combination therapy. Target lesions were chosen according to RECIST 1.1 guidelines. All target lesions were segmented on portal-venous phase CT using mint Lesion 3.4, and the following radiomics features were extracted: long axis, short axis, volume, entropy, kurtosis, skewness, mean of positive pixels (MPP), and uniformity of distribution of positive gray-level pixel values (UPP). Results were compared to maximum diameters at the lesional level.

RESULTS

The 28 lesions were followed for mean of 13 months (range 3 to 27 months); this yielded a total of 152 distinct lesional timepoint assessments. Baseline mean Dmax=2.6 cm, and volume=9.1 cc. Best individual lesion responses by Dmax were as follows: 5 lesions disappeared, 13 decreased by at least 30%, 3 remained stable, and 7 progressed by at least 20%. Decrease in Dmax at 3-month follow-up was highly associated with non-progressive disease (p=0.0004, Wilcoxon rank-sum), as were decreases in short axis and volume (p=0.003 and 0.0003, respectively). Of textural features, only decreases in kurtosis, entropy, and skewness were associated with lesion non-progression (p=0.04, 0.04, and 0.03, respectively).

CONCLUSION

Morphologic changes in ASPS lesions at 3-months are strong predictors of durable response; while in isolated cases early and

predictive changes in image textural parameters were observed, in general these parameters do not substantially improve response prediction over Dmax at the 3-month time-point.

CLINICAL RELEVANCE/APPLICATION

In ASPS treated with this immunotherapy-based regimen, one-dimensional assessments at 3 months are sufficient to predict durable lesion response.

SSA14-09 Organ Dose and Total Effective Dose of Whole-Body CT in Multiple Myeloma Patients

Sunday, Dec. 1 12:05PM - 12:15PM Room: E450B

Participants
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PURPOSE

Whole body low-dose CT (WBLDCT) plays an important role in the work-up of patients with plasma cell disorders and has recently been incorporated in the International Myeloma Working Group criteria for multiple myeloma (MM). However, data are lacking on the radiation exposure of such CTs. The purpose of this study was to evaluate organ dose and total effective dose of WBLDCT performed on different CT scanners in patients with MM and to compare it to the effective dose of a radiographic skeletal survey and typical diagnostic CTs. We hypothesized that the effective dose of WBLDCT would be lower than that of diagnostic CTs and higher than that of a skeletal survey.

METHOD AND MATERIALS

Our study was IRB approved and HIPAA compliant. We retrospectively analyzed data from 228 patients (47.4% females, mean age 67.9±10.4 years, mean weight 81.8±22.4 kg) who underwent WBLDCT for the work-up or surveillance of MM. Patients were scanned using one of our six multi-detector CT-scanners (Figure 1). Organ doses and total effective doses per scan were calculated using a commercially available dose management platform (Radimetrics, Bayer Healthcare, Leverkusen, Germany). The median effective dose was then compared to radiographic skeletal survey and representative diagnostic CTs performed in our institution.

RESULTS

The mean effective dose of our WBLDCT-protocol was 4.82 mSv. A significant higher effective dose was observed in females compared to males (4.95 mSv vs. 4.70 mSv, P=0.002). The mean organ dose ranged from 3.72 mSv (esophagus) to 13.09 mSv (skeleton). The mean effective dose varied amongst different CT-scanners (range 4.34-8.37 mSv) (Figure 1). The median effective dose of WBLDCT was more than twice the dose of a skeletal survey (4.82 vs 2.04 mSv), 23% higher than a diagnostic contrast-enhanced chest CT (3.9 mSv), 46% lower than a diagnostic contrast-enhanced abdomen/pelvis CT (9.0 mSv), and 45% lower than a lumbar spine CT (8.7 mSv).

CONCLUSION

WBLDCT in MM has a higher effective dose than a radiographic skeletal survey, but a lower effective dose than diagnostic CTs of the lumbar spine, abdomen and pelvis. This underlines the broad applicability of WBLDCT in the management of MM patients.

CLINICAL RELEVANCE/APPLICATION

The additional diagnostic value of low-dose whole-body CT in the management of MM patients outweighs the relatively limited additional radiation dose as compared to a radiographic skeletal survey.

SSA15

Science Session with Keynote: Musculoskeletal (Pelvis and Hip)

Sunday, Dec. 1 10:45AM - 12:15PM Room: E451A

MK

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Darryl B. Sneag, MD, Plainview, NY (*Moderator*) Nothing to Disclose
Luca Maria Sconfienza, MD, PhD, Milano, Italy (*Moderator*) Travel support, Bracco Group; Travel support, Esaote SpA; Travel support, ABIOGEN PHARMA SpA; Speakers Bureau, Fidia Pharma Group SpA

Sub-Events

SSA15-01 The Effect of Deep Convolution Neural Networks on Radiologists' Performance in the Detection of Hip Fractures on Digital Pelvic Radiographs

Sunday, Dec. 1 10:45AM - 10:55AM Room: E451A

Participants
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PURPOSE

In the case of radiographically occult hip fractures, patients undergo further imaging, including additional CT or MRI. The purpose of our study is to develop an automated deep learning system (Deep Convolutional Neural Network: DCNN) for detecting hip fractures using CT or MRI as a gold standard, and to evaluate the diagnostic performance of 7 readers with and without DCNN.

METHOD AND MATERIALS

The study population consisted of 327 patients who underwent pelvic CT or MRI and were diagnosed as femoral fractures. Radiography was performed in all cases. All radiographs were manually checked and annotated by radiologists referring to CT or MRI for selecting ROI. At first, a DCNN with architecture of GoogleNet model was trained by 302 cases. The remaining 25 cases and 25 control subjects were used for the observer performance study and for the testing of DCNN. Seven readers of radiologists with 9,13 and 24-year experience, an orthopedist with 22-year experience, a radiology trainee with 3-year experience, a general physician with 4-year experience and a senior resident took part in this study. A continuous rating scale was used to record each observer's confidence level.Subsequently, each observer read the radiographs with the DCNN outputs and rated again. The observer performance was evaluated by using receiver operating characteristic (ROC) analysis. The area under each ROC curve (AUC) was used to compare in detecting fractures with and without the DCNN output.

RESULTS

The AUCs of the 7 readers were 0.920,0.886, 0.842 0.839, 0.827, 0.810, and 0.698, respectively. The average AUC of the 7 observers was 0.832. The AUC of DCNN alone was 0.905. The AUCs of the 7 readers with DCNN outputs were 0.934,0.928, 0.896 0.866, 0.862, 0.841, and 0.800 respectively. The average AUC of the 7 readers with DCNN outputs was 0.876. The AUC of both experienced and less-experienced readers with DCNN output were higher than those without, respectively ($p<0.05$). The AUC of the 2 experienced readers with DCNN output exceeded the AUC of DCNN alone.

CONCLUSION

For detecting the hip fractures on radiographs, DCNN developed using CT or MRI as a gold standard by radiologists improved the diagnostic performance including the experienced readers.

CLINICAL RELEVANCE/APPLICATION

For detecting the hip fractures on Xp, DCNN developed using the higher-level reference standards increased the efficiency of diagnosis. This methodology provides more accurate data labeling.

SSA15-02 Hip Abductor Pathology in Ischiofemoral Impingement

Sunday, Dec. 1 10:55AM - 11:05AM Room: E451A

Participants
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PURPOSE

Ischiofemoral impingement (IFI) is associated with abnormalities of the quadratus femoris muscle and narrowing of the ischiofemoral (IF) and quadratus femoris (QF) spaces. The hip abductors play important roles in pelvic stability. We hypothesized that abductor insufficiency might be a contributing factor to the development of IFI. The purpose of our study was to assess hip abductor pathology in patients with IFI.

METHOD AND MATERIALS

The study was IRB approved and HIPAA compliant. The study group comprised 140 patients with IFI (mean age: 56±13 y, 130 f, 10 m) and 140 age and gender-matched controls without IFI. Two MSK radiologists performed measurements of IF and QF distances, assessed quadratus femoris muscle for edema and atrophy, and the integrity of the tensor fascia lata, gluteus medius and minimus tendons. IFI and control groups were compared with a two-tailed t-test or Fisher's exact test.

RESULTS

As expected, patients with IFI had decreased IF and QF distances ($p<0.0001$) compared to controls. All patients with IFI had abnormalities of the quadratus femoris muscle, whereas the QF muscle was normal in controls ($p<0.0001$). Patients with IFI had a higher prevalence of gluteal medius and minmus partial and full-thickness tears compared to controls ($p=0.007$). There were no tears of the tensor fascia lata in either group.

CONCLUSION

Abductor insufficiency might play a role in the pathophysiology of IFI in elderly patients. This emphasizes the need of abductor strengthening or repair in the treatment of IFI.

CLINICAL RELEVANCE/APPLICATION

Physical therapy focusing on abductor strengthening might become a first line non-invasive therapeutic approach to treat ischiofemoral impingement.

SSA15-03 Greater Trochanteric Pain Syndrome: An Association with the Iliac-trochanteric-shaft Angle

Sunday, Dec. 1 11:05AM - 11:15AM Room: E451A

Participants
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PURPOSE

Greater trochanteric pain syndrome (GTPS) is a common cause of lateral hip pain. Repetitive friction between the greater trochanter (GT) and iliotibial band (ITB) is a proposed cause and thought to be related to altered ITB kinematics and gait patterns. The purpose of this study is to assess if the angle of the ITB as it passes from its iliac origin over the GT to its tibial insertion is associated with GTPS.

METHOD AND MATERIALS

Consecutive subjects with a clinical diagnosis of GTPS and MRI features consistent with GTPS (GT bursitis, gluteal tendinosis) were included. The angle subtended from the iliac origin of the ITB to the lateral femoral shaft with apex at the GT was recorded (iliac-trochanteric-shaft angle, ITS). The grade of GTB and gluteus minimus and medius tendinosis as well as the femoral neck-shaft angle (FNS), center edge angle (CEA) and patient demographics were recorded. Consecutive age and gender matched controls with hip MRI performed for indications other than GTPS and with an absence of radiological features of GTPS were identified and the ITS angle, FNS angle and CEA were recorded. Student's t-test was utilised to evaluate for differences between subjects and controls.

RESULTS

106 subject and 106 control exams were included (64% female, 36% male). Mean ages were similar (56.9 vs 55.3 yrs respectively, p 0.69). The mean and median ITS angles were 158.2/158° and 166.9/165° respectively (p 0.0001) with the difference significant for both males and females. No difference was observed in FNS angle (131.6 vs 131.8°, p 0.83) and CEA (34.7 vs 33.6°, p 0.21). In the subject cohort GTB was present in 84% (mild 58%, moderate 20%, severe 6%). Gluteus minimus tendinosis was present in 90% (mild 54%, moderate 32%, severe 4%) and gluteus medius tendinosis was present in 80% (mild 52%, moderate 24%, severe 4%) with an association between decreasing ITS angle and increasing grade of GTB and gluteal tendinosis.

CONCLUSION

Increasing acuity of the angle of the ITB from its origin as it crosses the GT represented by the ITS angle is associated with clinical and radiological GTPS likely as a result of altered kinematics and increased friction with the peritrochanteric structures associated with GTPS.

CLINICAL RELEVANCE/APPLICATION

ITS angle is a simple measurement which could potentially identify patients at risk of developing GTPS and may have implications for treatment and preventative strategies.

SSA15-04 AIIS and Subspinous Impingement: When Do Two Become One?

Sunday, Dec. 1 11:15AM - 11:25AM Room: E451A

Participants
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PURPOSE

The morphology of the anterior inferior iliac spine (AIIS) and subspinous region (SS) are increasingly identified as important components in the spectrum of extra-articular hip impingement (EA-HI). These regions are anatomically distinct and accurate classification of impinging morphology is critical in guiding management. SS morphology has been classified arthroscopically, however, no radiological classification exists. The purpose of this study is to classify the spectrum of morphology and imaging appearances of the AIIS and SS on MRI and CT and to evaluate for an association between their morphology and the presence of EA-HI. We will also discuss the validity of MRI in the evaluation of SS and AIIS morphology as well as appropriate imaging protocols in the assessment of EA-HI.

METHOD AND MATERIALS

Consecutive patients under 50 years old with clinical hip impingement and available MRI and/or CT of hip were included. Age matched controls with an absence of clinical hip impingement and labral tear on imaging were selected. Studies were reviewed by two MSK radiologists in consensus for AIIS and SS morphology as well as radiological features of hip impingement including rectus femoris origin pathology, pericapsular edema, femoroacetabular impingement (FAI) and acetabular labral tear. Exclusion criteria included fracture, osteoarthritis and active core injury.

RESULTS

60 subject and 40 control exams were included (62.5% male, 37.5% female). All patients had an MRI, 20% of patients also had a CT for review. Abnormal morphology of the AIIS (case vs controls: 55% vs 29.5%, p=0.04) and SS (55% vs 29.5%, p=0.05) was associated with EA-HI and labral tears. 42% had combined AIIS and SS impingement. AIIS or SS impingement coexisted with FAI in 32.5% of cases vs 12.5% of controls (p=0.02). There was a strong correlation between MRI and CT morphology classification (r=0.7).

CONCLUSION

AIIS and SS impingement are separate entities in close anatomic proximity which frequently coexist as causes of EA-HI. Distinct classification systems as well as a high index of suspicion and knowledge of normal AIIS and SS anatomy, variant morphology and pathology are crucial to accurately diagnose and treat EA-HI.

CLINICAL RELEVANCE/APPLICATION

AIIS and SS impingement are distinct causes of EA-HI. The approach to surgical management is different and a knowledge of normal and variant morphology is crucial to accurately guide intervention.

SSA15-05 Prevalence of Femoral Retroversion is High and Depends on the Measurement Method in Patients with Unilateral SCFE: A Controlled CT-Based Study

Sunday, Dec. 1 11:25AM - 11:35AM Room: E451A

Participants
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PURPOSE

The optimal surgical treatment in patients with healed slipped capital femoral epiphysis (SCFE) and secondary hip impingement is controversial. Although commonly linked with femoral retroversion, prevalence of femoral retroversion in SCFE is unknown. We sought to: determine the prevalence of femoral retroversion in affected and unaffected hips using different measurement methods in patients with unilateral SCFE.

METHOD AND MATERIALS

A retrospective, controlled study on 79 symptomatic patients (mean age of 15 ± 4 years; 38 [48%] males) with unilateral SCFE and pelvic CT scans including the femoral condyles. Fifty-six (71%) patients had undergone previous in-situ fixation and presented with secondary impingement. Four common measurement methods for femoral version were used to compare SCFE hips and the contralateral, unaffected hips. Methods included the femoral head center and differed regarding the level of the landmarks for the proximal femoral reference axis. From proximal to distal: Lee et al.- (most proximal connection of the femoral neck and greater trochanter), Reikeras et al.- (femoral neck center where anterior and posterior cortices run parallel) -, Tomczak et al.- (center of the greater trochanter at the femoral neck base)- and Murphy et al.- (base of the femoral neck superior to the lesser trochanter) methods. Prevalence of femoral retroversion (<0°) and femoral version were compared.

RESULTS

In SCFE hips the more proximal methods according to Lee et al. (mean femoral version, -19°±16°), Reikeras et al. (-15° ± 14°) yielded a higher prevalence of retroversion with 91%, 84% versus 47%, 60% compared to the more distal methods of Tomczak et al. (0°±13°) and Murphy et al. (-4°±16°), (all p <0.001). By contrast prevalence of retroversion was lower in the unaffected hips for the respective measurement methods (all p <0.001): Lee et al. 42% (2°±12°), Reikeras et al. 32% (5°±11°), Tomczak et al. 5% (18°±11°), Murphy et al. 4% (19°±13°).

CONCLUSION

Prevalence of femoral retroversion is high in SCFE and depends on the measurement method. Thus, to avoid errors in treatment planning a consistent measurement method including respective reference intervals should be used.

CLINICAL RELEVANCE/APPLICATION

Routine measurement of femoral version in SCFE could help surgeons to identify hips in which an additional femoral osteotomy is needed to correct a retroverted femur or whether cam correction alone is sufficient.

SSA15-06 MRI Assessment of Subspine Impingement: Features Beyond Anterior Inferior Iliac Spine Morphology

Sunday, Dec. 1 11:35AM - 11:45AM Room: E451A

Participants
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Thomas Youm, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the MRI features associated with subspine impingement (SSI) including the osseous morphology of the anterior inferior iliac spine (AIIS) and femoral cam and associated soft tissue injuries.

METHOD AND MATERIALS

We performed a retrospective study of symptomatic patients who underwent arthroscopic treatment for femoroacetabular impingement (FAI) between December 2014 and March 2017. A subset of patients who had clinical and intraoperative findings of SSI were selected as the SSI group and the rest made the FAI group. Patients included had preoperative MRI within 6 months from surgery. Preoperative MRI was assessed by two radiologists independently and blinded to clinical information for AIIS morphology, presence of distal cam (we defined it as bump more distal to the head neck junction), signs of impingement on the distal femoral neck including sclerosis, edema, or cystic changes of the femoral neck and femoral neck synovial edema, edema of the superior capsule and rectus femoris tendon (RFT) at the AIIS level, and presence and location of chondrolabral lesions. The inter-reader agreement was also assessed.

RESULTS

Total of 62 patients with FAI met the inclusion criteria. 20 patients out of 62 (32%) were also diagnosed with SSI. The mean time difference between the MRI and arthroscopy was 4.1 ± 1.8 months. Distal cam was present in 80% of patients with SSI and in 19% of patients with FAI (p<0.001). We found no significant difference in AIIS morphology variants between the two groups. There was statistically significant difference in presence of signs of impingement on the distal femoral neck (77% vs 18%) between SSI and FAI groups respectively (p<0.001). Superior capsular edema was present in 80% in SSI and 29% in FAI group (p<0.05). No significant difference was between two groups regarding RFT edema and presence or location of chondrolabral lesions. There was substantial agreement between readers for detecting distal cam (kappa=0.80) and anterior chondral lesions (kappa=0.62), and moderate agreement for signs of distal femoral neck impingement, anterior labral and superior chondral lesions.

CONCLUSION

Our study showed that in addition to osseous morphology, there are associated soft tissue injuries which can be utilized to improve the accuracy of SSI diagnosis.

CLINICAL RELEVANCE/APPLICATION

Several osseous and soft tissue pathologies can be used to enhance the accuracy of detecting SSI in patient with FAI.

SSA15-07 Ultra-low Dose CT of the Pelvis: Applying Tin Prefiltration to Achieve a Radiation Dose Equivalent or Lower Than Radiographs

Sunday, Dec. 1 11:45AM - 11:55AM Room: E451A

Participants
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PURPOSE

The aim of this study was to develop an ultra-low dose pelvic CT protocol using tin prefiltration for spectral shaping of the x-ray beam to achieve a dose equivalent or lower than radiographs and to provide a virtual diagnostic radiograph.

METHOD AND MATERIALS

Three pelvic cadavers received standard pelvic radiographs and were repeatedly scanned on a 128-detector row CT scanner with identical pitch, slice thickness and iterative reconstruction strength: 1) conventional dose and reduced dose scan with tin prefiltration, both with automated tube voltage and current modulation; 2) successive tin prefiltered ultra-low dose scans with two dose equivalent protocols up to a maximum dose of a standard radiograph of the pelvis (0.44mSv) using a fixed tube voltage (Sn100kV and Sn140kV) and a fixed tube current (138-277mAs and 25-50mAs). Radiation dose was compared and virtual radiographs of CT data were computed using a customized cone-beam algorithm in Matlab (MathWorks). CT image quality was assessed quantitatively by signal- and contrast-to-noise ratio (SNR,CNR) and figure of merit (FOM) for CNR dose efficiency. On a 5-point scale CT images and virtual radiographs were rated qualitatively by two readers.

RESULTS

For each of the three cadavers no substantial difference was observed for SNR, CNR and FOM between ultra-low dose protocols. The ultra-low dose protocol with Sn140kV/50mAs that performed best in all 3 cadavers was chosen by consensus reading: overall image quality was rated good (mean 4.3 and 4.3, for reader 1 and 2 respectively), image noise weak to minimal (mean 4.0 and 4.7) and artifacts almost none (mean 4.7 and 4.7). Mean effective dose (0.36mSv) was substantially lower compared to conventional dose (mean 3.08mSv; -88% reduction) und reduced dose (1.88mSv; -81%) scans. Overall subjective image quality of the three virtual radiographs was rated excellent (mean 4.7 and 4.7).

CONCLUSION

We showed the feasibility of ultra-low dose pelvic CT scans of cadavers with tin prefiltration with a dose less than a conventional radiograph. The reconstructed virtual radiographs exhibited excellent image quality.

CLINICAL RELEVANCE/APPLICATION

Standard radiographs of the pelvis can be replaced by an ultra-low dose pelvic CT scan providing both cross-sectional information and a virtual radiograph with a dose below standard radiographs.

SSA15-08 Evaluation of Athletic Pubalgia in the Setting of Femoroacetabular Impingement

Sunday, Dec. 1 11:55AM - 12:05PM Room: E451A

Awards
Trainee Research Prize - Resident

Participants
Sowmya L. Varada, MD, New York, NY (*Presenter*) Nothing to Disclose
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Fangbai Wu, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the incidence of athletic pubalgia in patients with femoroacetabular impingement (FAI) on MRI.

METHOD AND MATERIALS

An IRB approved retrospective search identified 134 patients (total 163 hips) with clinical or imaging diagnosis of femoroacetabular impingement (FAI) who had a hip MRI between January 2015 and July 2018. Patients who had prior hip surgery were excluded. Two fellowship trained musculoskeletal radiologists blindly reviewed all studies in consensus and evaluated for the presence of: acute/chronic osteitis pubis, adductor/abdominis rectus tendinosis and tear, and aponeurotic plate tear. Demographic data (age, sex, sports participation, and treatment) was obtained from the electronic medical record. Imaging data (femoral version, acetabular version, alpha angle, and lateral center edge angle) were obtained from reports or measured by a third blinded musculoskeletal radiologist. Statistics included t-test, chi-square test, and one-way ANOVA with significance set to $p < 0.05$.

RESULTS

Incidence of pubalgia findings: Aponeurotic tear (14%), adductor tendinosis (71%), adductor tendon tear (10%), abdominis rectus tendinosis (1%), abdominis rectus tendon tear (<1%), acute osteitis pubis (14%), chronic osteitis pubis (42%). Incidence of treated pubalgia findings: Aponeurotic tear 30% (7/23), adductor tendinosis 14% (16/115), adductor tear 71% (12/17), acute osteitis pubis 26% (5/19), and chronic osteitis pubis 7% (4/56). Demographic/imaging data compared with pubalgia findings: Male vs. Female: adductor tendon tears 14% (16/115) vs. 2% (1/48) ($p = 0.024$) and acute osteitis pubis 19% (17/90) vs. 5% (2/42) ($p = 0.025$). Sports participation vs. No history of sports: adductor tendon tears 20% (12/61) vs. 5% (5/102) ($p = 0.003$) and chronic osteitis pubis 56% (28/50) vs. 33% (28/84) ($p = 0.010$). Alpha angle > 60° vs. Alpha angle < 60°: Chronic osteitis pubis 50% (44/88) vs. 26% (12/46) ($p = 0.008$). All other differences in demographic and imaging data were not significant when assessed against the pubalgia findings.

CONCLUSION

There is a high incidence of athletic pubalgia in FAI patients with certain findings found more commonly in males, in those with prior sports participation, and in the presence of a cam lesion.

CLINICAL RELEVANCE/APPLICATION

Identification of co-existent pubalgia findings with FAI may alter patient management. Our results add to the growing theory that there is pathophysiologic interplay between the two processes.

SSA15-09 Musculoskeletal Keynote Speaker: Therapeutic Arthrogram of the Hip for Adhesive Capsulitis - An Innovative Treatment Procedure that Reduces Capsular Stiffness and Increases Muscle Activation

Sunday, Dec. 1 12:05PM - 12:15PM Room: E451A

Participants
Anthony T. Mascia, MD, Toronto, ON (*Presenter*) Nothing to Disclose

Printed on: 10/29/20

SSA16

Nuclear Medicine (Genitourinary Oncology Nuclear Medicine and PET)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S505AB

CT GU NM OI

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
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Sonya Y. Park, MD, Seoul, Korea, Republic Of (*Moderator*) Nothing to Disclose

Sub-Events

SSA16-01 AI Pipeline System for Detection of Bone Metastases on PET-CT

Sunday, Dec. 1 10:45AM - 10:55AM Room: S505AB

Participants
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PURPOSE

To develop a machine learning system for the detection of bone metastases from the data of CT based on ground truth generated from 18F-fluorodeoxyglucose (FDG) PET.

METHOD AND MATERIALS

In this study, 198 whole body PET-CT examinations (105 men and 93 women; mean age, 63.8 years ± 12.9 [standard deviation]) with one or more bone metastases were retrospectively evaluated. At first, an automated annotation generation tool for bone metastases was created to extract lesions from PET. A binary bone mask was obtained from CT and multiplied with the rescaled PET volume. This resulted in a PET volume with FDG uptake in bones only. A convolutional neural network (CNN), ResNet-50, was then used to discard high FDG uptake regions which did not correspond to bone metastases, such as brain or bladder. Each candidate of bone metastasis was assigned a unique lesion number before it was converted into slice-wise bounding boxes. Secondly, one of the authors labeled each automatically extracted lesion with osteoblastic metastasis, osteolytic metastasis, intertrabecular metastasis and other. The 198 examinations were split in 173 examinations for training and 25 examinations for validation. A Mask R-CNN model was trained on the training set using labeled bounding boxes as ground truth. Finally, prediction accuracy was measured on the validation set.

RESULTS

In a total of 198 examinations, 1263 lesions were detected with the annotation tool and composed of 364 osteoblastic metastases, 365 osteolytic metastases, 24 intertrabecular metastases, and 510 others such as normal lesions, postoperative lesions, degenerative changes, and inflammation. The sensitivity was 77.8% for osteoblastic metastases, 54.2% for osteolytic metastases, and 100% for penetrating metastases with a false positive per image of 0.701 in the validation datasets.

CONCLUSION

We successfully developed an AI pipeline system to detect bone metastases from the data of CT and FDG-PET. This is the first report on an AI-based automatic annotation system for PET-CT. Some limitations such as the low sensitivity for osteolytic metastases and too many false positives should be improved.

CLINICAL RELEVANCE/APPLICATION

Since the sensitivity for osteoblastic metastases was higher than that in the previous paper on human detection, our AI system can reduce the oversight of radiologists to detect bone metastases on CT.

SSA16-02 Detection of Seminal Vesicle Involvement and Extra-Prostatic Extension of Primary Prostate Cancer by Fluciclovine PET-CT

Sunday, Dec. 1 10:55AM - 11:05AM Room: S505AB

Participants
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PURPOSE

To evaluate the diagnostic performance of fluciclovine PET-CT in determining the extent of primary prostate cancer specifically seminal vesicle involvement (SVI) and extra-prostatic extension (EPE).

METHOD AND MATERIALS

51 patients with high risk primary prostate cancer, without conventional imaging findings of systemic metastasis, deemed eligible for potential curative surgery were recruited and underwent fluciclovine PET-CT after obtaining informed consent. Image interpretation was performed by a board-certified nuclear medicine physician blinded to other clinical and imaging data. Abnormal or absent uptake indicating the presence or absence of SVI and EPE was recorded. Histologic findings of SVI and EPE were compared with preoperative imaging results. Measures of diagnostic performance of fluciclovine PET-CT were assessed. Equivocal interpretations were analyzed as negative.

RESULTS

44/51 patients with a mean ± SD PSA of 25.8 ± 31.1 ng/ ml underwent radical prostatectomy and extended lymph node dissection within 11.8 ± 9.9 days of imaging. The remaining 7 were excluded from the final analysis as they were either still awaiting surgery or considered unsuitable for curative surgery. 28/44 and 20/44 patients were interpreted as positive for SVI and ECE respectively on fluciclovine PET-CT. On histology, 20/44 and 36/44 were positive for SVI and ECE respectively. Consequently, sensitivity, specificity and positive predictive value (PPV) of fluciclovine PET-CT for determination of SVI were: 80%, 50% and 57.1% respectively. For assessment of EPE, sensitivity, specificity and PPV of fluciclovine PET-CT were: 50%, 75% and 90% respectively.

CONCLUSION

Fluciclovine PET/CT showed high sensitivity and moderate PPV in the detection of SVI in primary prostate cancer. It also demonstrated high positive predictive value and moderate specificity in the detection of EPE.

CLINICAL RELEVANCE/APPLICATION

Fluciclovine PET/CT may be of use in preoperative determination of tumor extent in primary prostate cancer and consequently choice of therapy. Further studies with PET/MR with better anatomic definition may therefore be beneficial.

SSA16-03 Combined Hybrid Axumin (18F- Fluciclovine) PET/MRI Interpretation Compared to the Individual Interpretation of Axumin PET and Dedicated Prostate MRI in Evaluating for Prostate Cancer Local Recurrence

Sunday, Dec. 1 11:05AM - 11:15AM Room: S505AB

Participants
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PURPOSE

To determine if evaluation for prostate cancer local recurrence with a combined reading of hybrid Axumin PET/MRI leads to more confident interpretation with fewer indeterminate results when compared to separate reading of Axumin PET and multiparametric prostate MRI (mpMRI).

METHOD AND MATERIALS

This is a retrospective study of 60 patients with biopsy-proven prostate cancer who have had definitive therapy with concern for recurrence, who underwent a hybrid Axumin PET/MRI. PET and MRI images were reviewed separately by a nuclear medicine and an abdominal imaging specialist, respectively, each blinded to the other. Lesions were assigned a likelihood of local recurrence score. Axumin PET/MRI images were then jointly interpreted and a consensus likelihood of local recurrence score was assigned. The scores were based on qualitative 5-point scales outlined by each reader prior to the study. Scores were compared between individual PET or MRI and combined PET/MRI interpretations using Chi-Square and linear-by-linear association tests.

RESULTS

We evaluated 60 Axumin PET-MRI exams with a total of 68 lesions. 39 (65%) patients had radical prostatectomy while 21 (35%)

had local therapy only. The average patient age was 69 years old (range 45-85). There is a significant difference in the interpretation scores between individual mpMRI and combined Axumin PET/MRI interpretation (p=0.006). Of the 24 lesions with scores of 2-4 on MRI, 9 (38%) lesions were downgraded to a score of 1 and 10 (42%) lesions were upgraded to a score of 5 on combined interpretation. There is a trend toward a significant difference between individual PET and combined PET/MRI, with a linear-by-linear association of 1.1 (p = 0.139). Of the 17 lesions assigned scores of 2-4 on PET, 5 (29%) lesions were upgraded to a score of 5 and 4 out of 43 lesions (9%) with a PET score of 1 were upgraded to a score of 5 on combined interpretation.

CONCLUSION

The combined interpretation of Axumin PET/MRI showed significantly more confidence in assessing for locally recurrent prostate cancer over interpretation of MRI alone and a trend toward significance in confidence over interpretation of PET alone.

CLINICAL RELEVANCE/APPLICATION

Combined reading of Axumin PET/MRI increases confidence in local recurrence detection, facilitating management in prostate cancer patients with clinical concern for recurrent disease after treatment.

SSA16-04 Tumor Foci Size but Not Lymph Node Size Affects 18F-fluciclovine PET/CT Detection of Metastatic Lymph Nodes in Primary Prostate Cancer

Sunday, Dec. 1 11:15AM - 11:25AM Room: S505AB

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David M. Schuster, MD, Decatur, GA (*Abstract Co-Author*) Institutional Research Grant, Nihon Medi-Physics Co, Ltd; Institutional Research Grant, Blue Earth Diagnostics Ltd; Institutional Research Grant, Advanced Accelerator Applications SA; Institutional Research Grant, Telix Pharmaceuticals Inc; Consultant, Syncona Ltd; Consultant, AIM Specialty Health, Inc; ;

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PURPOSE

To determine the effect of sizes of lymph node (LN) and metastatic foci (MF) on the diagnostic performance of preoperative fluciclovine PET/CT for identifying LN metastasis (LNM) in patients with primary prostate cancer.

METHOD AND MATERIALS

51 patients with intermediate to high-risk prostate cancer underwent fluciclovine PET/CT (Dose: 366.3±22.2 MBq) prior to radical robotic prostatectomy (RP) with extended pelvic lymph node dissection (EPLND). LNs were excised according to 12 predefined templates and correlated to PET findings. Metastatic LNs and MF in LNs were measured bidimensionally by a board certified urologic pathologist. Sizes of metastatic LNs and MF in templates with positive and negative PET findings were compared using t-test. For every LN packet (LNP), the greatest long axis diameter of LN and MF were utilized as the most conservative surrogate for the LNP.

RESULTS

EPLND was performed in 45/51 patients with median PSA 18.0 ng/ml (range 0.58-147.03 ng/ml) and Gleason score (Grade group) 8 (4) within 7 days (range 1-41 days) after fluciclovine PET. Of these, 24/45 (53.3%) patients had histologically confirmed LNM. 508 LNPs (mean 11 packets per patient) were analyzed. LNM were detected in 82/508 (16.1%) LNPs on histology. Fluciclovine PET detected LNM in 36/82 (43.9%) LNPs (true positives) while 46/82 (56.1%) LNPs were either benign or not seen (false negatives) on fluciclovine PET. Of the remaining 426/508 LNPs, 3/426 (0.7%) were read as equivocal on PET but were benign on histology (false positives). There was no significant difference in the mean long axis diameters of true positives (15.1 mm [range 3.0-40.0 mm]) and false negatives (13.1 mm [range 3.0-52.0 mm]; p=0.13) LNPs. In contrast, the mean long axis diameters of MF within true positive LNPs (11.4 mm [range 1.0-40.0 mm]) were significantly higher than false negative LNPs (3.9 mm [range 0.4-14.0 mm]; p<0.01). 13/52 (25.0%) LNPs with MF <=7 mm were detected on fluciclovine PET while 23/30 (76.7%) LNPs with MF >7 mm were detected on fluciclovine PET.

CONCLUSION

Fluciclovine PET detection rate of LNM was influenced by the size of metastatic foci but not lymph node size. Metastatic foci >7 mm were more likely to be detected on fluciclovine PET than MF <=7 mm.

CLINICAL RELEVANCE/APPLICATION

The ability of preoperative fluciclovine PET/CT to detect lymph node metastasis in patients with primary prostate cancer is influenced by the size of the metastatic focus within the lymph node.

SSA16-05 Difference in the Spectrum of Metastatic Disease on 68Ga PSMA PET/CT after Radical Prostatectomy and after Radical Radiotherapy in Patients of Carcinoma Prostate with Biochemical Recurrence

Sunday, Dec. 1 11:25AM - 11:35AM Room: S505AB

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PURPOSE

To determine the pattern of metastatic disease with 68Ga PSMA PET/CT in patients with biochemical recurrence after definitive treatment

METHOD AND MATERIALS

A retrospective analysis of subjects with carcinoma prostate, who had undergone definitive treatment (Radical prostatectomy or Radiotherapy) and presented with biochemical recurrence, was done by 68Ga PSMA PET/CT. The data collected was analysed to establish temporal occurrence and patterns of regional and distant metastatic disease in both the groups and correlated with serum PSA levels.

RESULTS

The study included 200 subjects with history of adenocarcinoma prostate. In the post radical prostatectomy group (n=144), median serum PSA was 1.8 ng/ml, the overall metastatic detection rate was 39.3% for PSA 0.2 to < 0.5 ng/ml, 47.3% for PSA 0.5 to < 1 ng/ml, 68.4% for PSA 1 to < 2 ng/ml and 93.1% for PSA >=2 ng/ml. In this group local recurrence was identified in 28.73 % and lymph nodal metastases in 65.1%, with the pelvic lymph nodal metastases being the most common site of metastasis followed by bone metastases. The mean time for serum PSA recurrence in the radical prostatectomy group was 49.77±44.44 months (range 2-184 months). In the post radiotherapy group, median serum PSA was 5.2 ng/ml, the detection rate was 88.8 % for PSA 2 to < 4 ng/ml and 100 % for PSA >= 4 ng/ ml. Local recurrence after radiotherapy was present in 79.5 % of the group and 63.6 % had lymph nodal metastases. The mean time for serum PSA recurrence following radiotherapy was 49.15± 24.32 months, (range 12-111 months).

CONCLUSION

Radical prostatectomy and Radical radiotherapy are the two standard treatment options for localized carcinoma prostate. Although the extent and patterns of recurrence differed in the two groups, the temporal occurrence of metastatic disease remained comparable.

CLINICAL RELEVANCE/APPLICATION

68Ga-PSMA has been suggested as a novel tracer for detection of prostate cancer relapse and metastases with high specificity and sensitivity.

SSA16-06 Correlation of Findings on 18F-Fluciclovine PET/CT with Failure-Free Survival of Salvage Radiotherapy in Post-Prostatectomy Patients with Biochemical Recurrence

Sunday, Dec. 1 11:35AM - 11:45AM Room: S505AB

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PURPOSE

To examine the impact of fluciclovine PET on failure-free survival (FFS) of radiotherapy (RT) ± androgen deprivation therapy (ADT) in recurrent prostate cancer patients post-prostatectomy.

METHOD AND MATERIALS

69 post-prostatectomy patients with biochemical recurrence in the experimental arm of a randomized controlled study (NCT01666808/NIH R01CA169188) underwent fluciclovine PET prior to RT±ADT. RT was based on PET and clinical findings: no

uptake/prostate bed only uptake - RT to prostate bed only, pelvic nodal uptake - RT to prostate bed+pelvis, extrapelvic nodal uptake - no RT. RT (median 66.6 Gy in 1.8 Gy fractions) was initiated 17±10 days after PET scan. 21 patients received RT+short course ADT. 8 patients at 12 months and 3 additional patients at 18 months post-RT were censored due to lack of follow-up. Treatment failure was defined as either serum prostate-specific antigen (PSA) >=0.2 ng/ml+post-RT nadir followed by another higher value, a continued rise in the serum PSA despite RT, initiation of systemic therapy after completion of RT, or clinical progression. FFS based on fluciclovine PET findings were compared using Fisher's exact test.

RESULTS

53/69 (76.8%) patients had positive fluciclovine PET findings. 4/69 patients were ineligible for RT due to systemic disease, hence, FFS was assessed in 65 patients (median PSA 0.32 [range 0.02-9.79] ng/ml). FFS at 6, 12 and 18 months was 63/65 (96.9%), 52/57 (91.2%), and 43/54 (79.6%), respectively. In patients with no uptake, FFS was 16/16 (100%), 15/15 (100%), 12/13 (92.3%) at 6, 12, and 18 months, respectively. In patients with uptake in the prostate bed only, FFS was 27/27 (100%), 21/22 (95.5%), 18/21 (85.7%) at 6, 12, and 18 months, respectively. In patients with pelvic±prostate bed uptake, FFS was 20/22 (90.9%), 16/20 (80.0%), 13/20 (65.0%) at 6, 12, and 18 months, respectively. FFS trends did not reach statistical significance at any timepoint.

CONCLUSION

Findings on fluciclovine PET/CT correlate with failure-free survival, potentially reflecting metabolic tumor burden and may have prognostic value. Longer follow-up duration and comparison to a control group not undergoing PET, are required to fully evaluate the value of fluciclovine PET based radiotherapy.

CLINICAL RELEVANCE/APPLICATION

Findings on fluciclovine PET/CT correlate with failure-free survival of salvage radiotherapy and may have prognostic value in post-prostatectomy patients with biochemical recurrence.

SSA16-08 Significant Interval Decrease in Bone Mineral Density in Osteopenic Patients: A Notable Limitation of FRAX Analysis in Dual-energy X-ray Absorptiometry

Sunday, Dec. 1 11:55AM - 12:05PM Room: S505AB

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PURPOSE

Bone mineral density (BMD) evaluation, considered to be the standard measure for the diagnosis of osteoporosis and fracture risk assessment, is most commonly measured by dual-energy x-ray absorptiometry (DXA). For patients diagnosed with osteopenia, the Fracture Risk Assessment Tool (FRAX) was developed, which incorporates clinical factors to aid the clinician in patient management. If the FRAX score in an osteopenic patient predicts a 10-year fracture risk of 20% or greater for a major osteoporotic fracture or 3% or greater for a hip fracture, therapy is warranted. However, any significant decline in BMD when compared to a prior DXA is not reflected in the FRAX analysis. Our goal was to determine the frequency with which there is a significant decline in BMD in patients diagnosed with osteopenia by DXA, but whose FRAX score predicts a fracture risk of less than 20% for a major osteoporotic fracture or less than 3% for a hip fracture.

METHOD AND MATERIALS

Over a period of 12 months, the number of patients diagnosed with osteopenia by DXA were counted, who (1) had a significant decrease in BMD when compared to a prior DXA and (2) the FRAX scores were both less than 20% for a major osteoporotic fracture and less than 3% for a hip fracture.

RESULTS

A total of 278 patients with osteopenia by DXA had a significant decrease in spine and/or hip BMD when compared to a previous DXA, yet the FRAX scores were both less than 20% for a major osteoporotic fracture and less than 3% for a hip fracture.

CONCLUSION

Fracture risk assessed by FRAX analysis is often underestimated in osteopenic patients whose BMD has significantly declined from a prior DXA. Therefore, in this clinical setting, a low FRAX score should not influence the therapeutic decision.

CLINICAL RELEVANCE/APPLICATION

The following sentence should be added to the DXA scan report in the above clinical scenario: "It should be noted that a significant decrease in BMD from a prior DXA is not reflected in FRAX analysis."

SSA16-09 Effect of Tumor Histology on Detection of Pelvic and Para-Aortic Nodal Metastasis with FDG-PET in Stage IB Cervical Cancer

Sunday, Dec. 1 12:05PM - 12:15PM Room: S505AB

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PURPOSE

To determine if the detection of FDG-avid pelvic and para-aortic lymph nodes in early stage cervical cancer patients is dependent on tumor histology.

METHOD AND MATERIALS

Patients with IB1-2 cervical cancer who underwent pre-surgical FDG-PET between 1997-2018 were identified in a tertiary academic center database. All patients had radical hysterectomy with pelvic and para-aortic lymph node dissection. The detection of pelvic and para-aortic lymph nodes by FDG-PET vs. surgical dissection was compared. FDG-PET sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were determined and stratified by tumor histology. Freedom from relapse (FFR) was analyzed with Kaplan-Meier analysis and Cox proportional hazards models.

RESULTS

We identified 212 patients with early-stage cervical cancer (84% FIGO IB1, 16% IB2) who underwent pre-surgical FDG-PET; 137(65%) had squamous carcinoma and 75(35%) had adenocarcinoma. PET/CT was performed in 189(89%) patients and 23(11%) had PET only. Surgical dissection revealed positive pelvic and para-aortic lymph nodes in 25% and 3.3% of patients, respectively. For squamous carcinoma, the sensitivity, specificity, PPV and NPV of FDG-PET for pelvic nodal metastasis were 44%, 99%, 95% and 78%, respectively. For adenocarcinoma, the corresponding results for pelvic nodal metastasis were 25%, 99%, 67% and 92%, respectively. The overall sensitivity, specificity, PPV and NPV of FDG-PET for para-aortic nodal metastasis was 29%, 99%, 67%, and 98%, respectively. With a median follow up of 9.3 years, the 5-year FFR for squamous carcinoma and adenocarcinoma was 83% vs. 96% (p=0.008), respectively.

CONCLUSION

Pelvic nodal metastasis was less likely to be detected by FDG-PET in patients with early-stage adenocarcinoma than with squamous carcinoma. Patients with adenocarcinoma had a better prognosis than those with squamous carcinoma.

CLINICAL RELEVANCE/APPLICATION

FDG-PET was half as sensitive for detecting pelvic lymph nodes in adenocarcinoma vs. squamous carcinoma.

Printed on: 10/29/20

SSA17

Neuroradiology (Stroke 1)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S501ABC

AI CT ER NR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

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Sub-Events

SSA17-01 A Deep Learning Algorithm for Detecting Challenging Cases of Acute Ischemic Stroke on Non-Contrast Brain CT

Sunday, Dec. 1 10:45AM - 10:55AM Room: S501ABC

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PURPOSE

Improving the diagnostic accuracy for acute ischemic stroke (AIS) has the potential to reduce erroneous administration of tissue plasminogen activator (tPA) to patients presenting with stroke-like symptoms. Non-contrast CT is obtained in the acute setting to rule out intracranial hemorrhage but has poor sensitivity and specificity for AIS. Thus, the most ambiguous cases are referred to Diffusion Weighted MRI (DW-MRI) after administration of tPA for diagnostic confirmation. The aim of this study is to produce stroke annotations on non-contrast CT images based on corresponding DW-MRIs in these challenging cases, and then automatically detect and segment AIS directly from non-contrast brain CT images.

METHOD AND MATERIALS

8879 CT slices from 199 patients CT scans were collected and split into training (75%), validation (15%), and test (10%) sets. Out of 199 patients, 99 patients were confirmed to have stroke based on DW-MRIs (positive samples), and 100 patients had no evidence of AIS based on clinical follow up (negative samples). Board-certified radiologists annotated the CT for AIS on positive samples by comparing to corresponding DW-MRIs. The training dataset was then passed through a Mask R-CNN model with a ResNet-50 backbone with L2 Regularization. The loss function was optimized by stochastic gradient descent with momentum. The model was initialized with weights pretrained on the Common Objects in Context dataset. The validation set was used to tune hyperparameters.

RESULTS

The model was assessed on the ability to identify a CT slice as containing a stroke and the ability to segment the regions of corresponding diffusion on MRI on the held-out test set. The model has a whole image classification specificity of 0.6849, sensitivity of 0.4792, F1 score of 0.1394, and accuracy of 0.6736. Additionally, the model demonstrated a promising ability to automatically segment AIS, achieving a mean average precision on true positive predictions of 0.3478 at an intersection-over-union of 10%.

CONCLUSION

Our Mask R-CNN model provides a promising means of detecting acute ischemic stroke on non-contrast CT.

CLINICAL RELEVANCE/APPLICATION

The algorithm can be used to improve the diagnostic accuracy for AIS on non-contrast CT in emergency settings to improve patient selection for intravenous thrombolysis and mechanical thrombectomy.

SSA17-02 Infarct Lesion Prediction Using Baseline MRI in Acute Ischemic Stroke Patients: A Comparison Study between Deep Learning Model and Clinical Thresholding Methods

Sunday, Dec. 1 10:55AM - 11:05AM Room: S501ABC

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PURPOSE

We aim to determine whether a deep learning model trained on acute stroke patients can predict the 3-7 day infarcted region from baseline DWI/PWI MRI and to compare its prediction with state-of-the-art clinical thresholding methods.

METHOD AND MATERIALS

Patients with baseline DWI/PWI and 3-7 day T2-FLAIR imaging were selected from two large acute ischemic stroke trials. Six image channels from baseline imaging were used as model inputs (DWI, ADC, and from PWI: Tmax, CBF, CBV, and MTT). Ground truth was manually segmented on 3-7 day T2-FLAIR. The network structure was an attention-gated deep convolutional U-net with a composite loss function. The model outputs a map where each voxel represents the probability of being part of the lesion. Patients were grouped into unknown, minimal, partial, major reperfusion status. Area-under-the-curve (AUC), Dice score coefficient (DSC), and predicted lesion volume difference were analyzed. In minimal and major reperfusion, the model was compared to a thresholding method (RAPID) using Tmax>6 sec and ADC<620 x 10-6 mm2/s by a paired sample Wilcoxon test, respectively.

RESULTS

182 patients were included (age 65±16 yrs, baseline NIHSS 15 [IQR 10-19]). For all patients, the model had a median AUC of 0.91 (IQR 0.87, 0.95); at 0.5 probability threshold, median DSC was 0.53 (IQR 0.31-0.68) and lesion volume differences were 9.1 ml (IQR -14.2-28.6) and 23.7 ml (IQR 11.4-50.1) (absolute difference). In minimal reperfusion patients, median AUC was 0.90 (IQR 0.85, 0.94) vs 0.78 (IQR 0.72, 0.82) for the Tmax model ($p<0.001$); in major reperfusion patients, median AUC was 0.93 (IQR 0.89, 0.96) vs 0.68 (IQR 0.62, 0.76) for the ADC model ($p<0.001$). In partial or unknown reperfusion patients, AUC was similar: 0.90 [IQR 0.86, 0.96] and 0.92 [IQR 0.86, 0.96], respectively.

CONCLUSION

A deep learning model trained without reperfusion status performs better at infarct lesion segmentation compared to commonly-used threshold-based methods in minimal and major reperfusion patients, while also achieving high performance in partial or unknown reperfusion patients.

CLINICAL RELEVANCE/APPLICATION

A deep learning model without reperfusion information trained on acute images can achieve good performance at predicting imaging outcome at 3-7 days.

SSA17-03 Quantitative Evaluation of Multiphase Versus Single Phase Computed Tomography Angiography for the Detection of Distal Ischemic Stroke

Sunday, Dec. 1 11:05AM - 11:15AM Room: S501ABC

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PURPOSE

The aim of this investigation was to quantitatively evaluate the effects of the addition of peak and delayed venous phase imaging to arterial phase CTA for the detection of distal ischemic strokes. Changes in sensitivity, specificity, time required to render a final decision, and subjective level of diagnostic confidence were quantified.

METHOD AND MATERIALS

Four attending radiologists contributed as readers to this IRB-approved, HIPAA-compliant study. For each reader, two sessions were conducted; in each session, the reader retrospectively interpreted the CTA studies of 104 patients (52 positive, 52 negative) who underwent imaging for suspicion of acute ischemic stroke, resulting in a total of 832 interpretations. During the first session for each reader, only arterial phase images were available; during the second session, peak and delayed venous phase images were additionally available. The patients' images were randomized and de-identified, and the two reading sessions for each radiologist

were separated by at least one month in order to minimize inter-session confounding. Data collected included presence or absence of arterial occlusion, time to render a final decision, and subjective level of diagnostic confidence.

RESULTS

The addition of venous phase images resulted in a significant 7.5% absolute increase in sensitivity (86.5% vs. 94.0%, p = .004) and an insignificant increase in specificity (98.2% vs. 99.0%, p = .387). No significant increase was observed in relative positive predictive value (97.2% vs. 98.1%, p = .511) but a small significant increase in relative negative predictive value was seen (87% vs. 91%, p = .001). A small but significant reduction in reading time was observed (66.7 seconds vs. 59.6 seconds, p = .001). A significant increase in diagnostic confidence was observed (2.26 vs. 2.58, p < .001). Inter-radiologist agreement (Kappa value) increased from 0.76 to 0.84.

CONCLUSION

The addition of peak and delayed venous phases to arterial phase CTA imaging for the detection of distal ischemic stroke significantly increases diagnostic sensitivity, reading speed, and reader confidence without incurring a corresponding reduction in specificity.

CLINICAL RELEVANCE/APPLICATION

By increasing sensitivity and reading speed at no cost to specificity, conducting multiphase imaging as a routine stroke protocol has the potential to improve diagnostic accuracy and patient outcomes.

SSA17-04 Deep Learning-Based Contrast Enhanced Time-Resolved Cone-Beam CT Angiography with IV Injection

Sunday, Dec. 1 11:15AM - 11:25AM Room: S501ABC

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PURPOSE

The purpose of this work was to develop a deep learning technique to generate time-resolved cone-beam CT angiography (TR-CBCTA) from cone-beam CT perfusion data sets.

METHOD AND MATERIALS

With IRB approval and written consent, 43 patients with acute ischemic stroke and a high NIH stroke scale scores (>5) were recruited in one-stop-shop C-arm cone beam CT stroke imaging clinical trial study. The recruited subjects received both diagnostic CT and C-arm cone-beam CT perfusion imaging. The C-arm cone beam CT perfusion data acquisitions consist of nine 5-seconds bidirectional rotational scans with 100 cc contrast medium injected intravenously followed by 50 cc saline flush. To generate TR-CBCTA, the acquired high quality diagnostic CT images were used to train our previously published deep learning angiography (DLA) neural network to extract vascular features from axial CT images. This trained deep neural network was transferred to learn TR-CBCTA from the acquired cone-beam CT perfusion data sets. To capture the spatiotemporal characteristics of TR-CBCTA, the trained DLA model was fine-tuned using images from the acquired cone-beam CT perfusion data sets. The trained model was then used to generate TR-CBCTA of other data sets from different patients. The generated TR-CBCTA images were subject to qualitative assessment of image quality of large arteries (i.e internal carotid artery - ICA, middle cerebral artery - MCA, anterior cerebral artery - ACA and the distal branches of the MCA and ACA) as well as the anatomy of the cerebral venous system. The presence/absence of residual bone and mis-registration artifacts was also evaluated.

RESULTS

All major arteries as well as venous drainage showed good to excellent image quality in time-resolved DLA images. No significant residual signal from osseous structures was observed.

CONCLUSION

A deep learning based method was developed to generate TR-CBCTA from cone-beam CT perfusion data sets with reduced mis-registration and residual bone artifacts induced by inter-sweep patient motion and known to be the major technical limitation.

CLINICAL RELEVANCE/APPLICATION

Time-resolved cone-beam CT angiography from cone-beam CT perfusion data sets may enable reliable use of c-arm based time-resolved CTA to directly visualize vascular occlusions and assess collaterals to ischemic stroke patients.

SSA17-05 Quantitative CT Perfusion: Do the CT Scanner Model and Variation in Vascular Flow Rate Affect Quantitative Measures of Parametric Maps?

Sunday, Dec. 1 11:25AM - 11:35AM Room: S501ABC

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PURPOSE

Using a CT perfusion phantom, we sought to determine whether quantitative measurements on CT perfusion maps differed between CT manufacturers and scanner models and to determine if differences in simulated blood flow rates affect these quantitative measurements.

METHOD AND MATERIALS

A unique CT perfusion phantom comprised of 4 movable rods was used in this study. The phantom contains 2 rods designed to simulate arterial and venous flow rates and 2 rods replicating identical normal perfused brain tissue. The simulated arterial and venous contrast rods are designed to move at 5 distinct speeds, allowing acquisition of datasets at 5 different simulated blood flow rates. Scanning was performed using standard clinical protocols on 3 different CT scanner models at each of the speeds. The CT phantom was scanned 5 times for one of the phantom speeds to confirm reproducibility. Datasets from each scan were post processed using commercial perfusion software to create time attenuation curves and parametric perfusion maps for cerebral blood volume (CBV), cerebral blood flow (CBF) and mean transit times (MTT). Region of interest (ROI) measurements in the simulated brain tissue rods were obtained for 3 centrally located scan slices.

RESULTS

Quantitative ROI measurements revealed that CBF values increased, MTT decreased, and CBV did not change with increased phantom speed, as expected, for all three CT scanner models. The absolute values of CBV and CBF were different across CT scan manufacturers, although closer in range between two models of a single CT manufacturer, for a given phantom speed. For example, at a simulated flow rate of 1.5 mm/sec measured at a central phantom slice position, CBF(ml/100g/min) was 17.7 for Scanner 1 (mfgr 1), 14.0 for Scanner 2 (mfgr 1), and 36.0 for Scanner 3 (mfgr 2); CBV(ml/100g) was 4.9 for Scanner 1, 4.2 for Scanner 2, and 7.8 for Scanner 3; MTT(sec) was 16.7 for Scanner 1, 18.0 for Scanner 2, and 16.2 for Scanner 3.

CONCLUSION

Scanner manufacturers and models yield substantially different quantitative ROI values; therefore, one must be cautious when using absolute values for interpreting CT perfusion images, particularly when attempting to devise threshold values for CBF and CBV.

CLINICAL RELEVANCE/APPLICATION

Since quantitative values are not consistent across CT scanners, one must be cautious when using them for interpreting CT perfusion, particularly if attempting to devise threshold values for CBF and CBV.

SSA17-06 Imaging Triage of Acute Stroke Patients for Endovascular Clot Retrieval (ECR): Audit of the Effects of Broadened Eligibility Criteria and Process Improvements on Utilisation of CT Perfusion at a Health Network Stroke Centre

Sunday, Dec. 1 11:35AM - 11:45AM Room: S501ABC

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PURPOSE

The DAWN and DEFUSE-3 trials published in 2017 showed improved outcomes for later-presenting acute stroke (AS) patients with large vessel occlusion treated with endovascular clot retrieval (ECR). At our institution we experienced a markedly increased volume of CT perfusion (CTP) studies for patients with potential AS during 2018. We aimed to determine if there were associations between: 1. liberalized temporal eligibility criteria and increased CTP utilization and 2. CTP utilization and number of patients having ECR who were discharged home.

METHOD AND MATERIALS

Audit of 3 hospital network. Inclusion: Consecutive. Suspected AS >18 years who had CTP. Study Period 1. 1 January-30 June 2017; Period 2. 1 January-30 June 2018. Data collection: Age, gender, hospital of presentation, triage category, NIHSS (National Institute of Health Stroke Score), symptoms / signs, time SLSW-triage, # patients reaching angiography for intended ECR (IECR), ECR performance, disposition (home / other). Number needed to scan (NNS) for 1 IECR =Total # CTP / total # IECR. Total ED presentations were calculated. Analysis: Comparison of periods 1. and 2. Student t, Wilcoxon Rank Sum and chi-square tests with significance set at $p < 0.05$.

RESULTS

A 38.6 % increase in CTP (515 in 2017, 714 in 2018) occurred with 42/515 (8.2%) and 76/714 (10.6%) proceeding to intended ECR (80.9% increase) . NNS declined from 12.3 to 9.4. 39/515 (7.6%) and 62/714 (8.7%) of patients had ECR (60.0% increase). >85% of patients in both periods were triage category 2 (CAT2) ; increase in all CAT2 ED presentations 2017-8 was 1.6%. 90/118 patients with IECR had complete data for analysis. Median time SLSW at triage differed between the two groups (median [244 mins (IQR: 95-600) in 2018 vs. 74.5 mins in 2017 (IQR: 53-205); $p < 0.0001$]. 23 and 28 patients who had ECR were discharged home in 2017 and 2018, respectively.

CONCLUSION

CTP volume grew between 2017 and 2018 well in excess of ED presentations. Median time SLSW was different between the two study periods. Reduction in NNS may reflect patient selection for CTP and/or changed decision-making after CTP. In 2018 versus 2017, 199 more CTPs were performed for an additional 5 ECR patients to be discharged home.

CLINICAL RELEVANCE/APPLICATION

Broadened temporal criteria for endovascular clot retrieval (ECR) in acute stroke (AS) are associated with substantial increase in CT perfusion utilization per ECR patient discharged home.

SSA17-07 Amide Proton Transfer Magnetic Resonance Imaging of Cerebral Infarction: Correlation with Clinico-Radiological Findings

Sunday, Dec. 1 11:45AM - 11:55AM Room: S501ABC

Participants
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PURPOSE

Amide proton transfer (APT) imaging is a kind of chemical exchange saturation transfer imaging technique based on proton exchange between amides (-NH) and bulk water. As proton exchange rate depends on tissue pH, APT imaging could detect pH reduction in cerebral infarctions. The purpose of this study was to clarify correlations between APT-weighted signal (APTws) and clinico-radiological findings in patients with infarctions.

METHOD AND MATERIALS

In this retrospective study, 29 patients (13 males and 16 females; age range 9-91 y.o.; median 65 y.o.) were examined with a 3T MR system. The infarction etiology was cardioembolic in 11 cases, atherosclerotic in 5 cases and others in 13 cases. The range of time after ictus was 1.8 to 720 h. (median 52.3 h.). The range of lesion size was 19 to 132 mm (median 50 mm). The parameters of APT imaging were as follows: saturation pulse strength = 1.5 μT, saturation time = 2.0 sec, 25 offset frequencies (±6 ppm). MTR asymmetry at 3.5ppm was defined as APTws. Regions-of-interest (ROIs) were manually drawn around the infarction and contralateral normal-appearing white matter (CNWM) on diffusion-weighted images, then these were copied onto the APT images. We measured cumulative histogram parameters, including 10th, 25th, 50th, 75th, 90th percentiles of APTws in infarction and CNWMs. Histogram parameters were compared between infarction and CNWM using Wilcoxon signed-rank test. Those were also compared between cardioembolic infarction and the other subtypes of infarctions using Mann-Whitney U test. Correlation between 10th percentile of APTws (APT10th) and time after ictus, lesion size and 10th percentile of ADC (ADC10th) were evaluated using Spearman`s rank correlation coefficient.

RESULTS

APT10th of infarction was significantly lower than that of CNWM (-1.69±1.80 vs. -1.12±1.73 %, p = 0.0381). APT10th of cardioembolic infarction were significantly lower than those of the other infarction subtypes (-2.77±2.42 vs. -1.02±0.82 %, p = 0.0144). APT10th positively correlated with ADC10th (r = 0.49, p = 0.0065) and inversely correlated with lesion size (r = -0.43, p = 0.0216). There was no significant correlation between APTws and time after ictus.

CONCLUSION

APTws was reduced in cardioembolic infarctions, large infarctions and infarctions with low ADC values.

CLINICAL RELEVANCE/APPLICATION

APT imaging could be used to evaluate tissue acidosis in cerebral infarctions.

SSA17-08 High B Values for Diffusion-Weighted Imaging at 3 Tesla Improves the Sensitivity for Acute Ischemic Stroke Detection

Sunday, Dec. 1 11:55AM - 12:05PM Room: S501ABC

Participants
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PURPOSE

MRI may be performed in the setting of acute neurological deficits, in order to diagnose ischemic stroke, rule out alternative diagnoses and select patients for further traitement. The diagnosis is based on the demonstration of diffusion weighted high-signal intensity with decreased apparent diffusion coefficient (ADC) value. The optimum b factor to use at 3T has never been defined in the literature, varying between 1000 and 2000; hence, this study compares 2 b factors : b1000, b2000 s/mm2 in evaluating recent cerebral ischemic lesions at 3T MRI.

METHOD AND MATERIALS

227 patients with a recent ongoing or transient neurological deficit (< 24h) were inclued over 3 months. We performed b1000 and

b2000 MR diffusion sequences 3T MRI in an emergency setting. These acquisitions were quantitatively and independently analysed by 2 readers, specifying the presence of an ischemic lesion and their diagnostic confidence. Inter-reader agreement, sensitivity, specificity, and positive and negative predictive values were calculated.

RESULTS

Recent ischemic lesions were detected in 78/227 patients (34.4%). The sensitivity for b2000 was significantly higher than for b1000 at 3T (98.7% vs 93.7%, p=0.05), whereas the specificty was equivalent (99.3% vs 97.3%, p=0.18). There was no statistical difference for diagnostic confidence.

CONCLUSION

MR diffusion sequence with a b factor of 2000 s/mm2 has a better sensitivity for the detection of recent ischemic lesions, compared to 1000 s/mm2 at 3T.

CLINICAL RELEVANCE/APPLICATION

DWI with a b factor of 2000 s/mm2 has a significantly higher sensitivity in diagnosing recent ischemic stroke compared to a b factor of 1000 s/mm2 and is recommended in the emergency setting.

SSA17-09 High Performance of Deep-Learning (DL) based Segmentation Model of Acute Ischemia Stroke Lesions Evaluated with ASPECTs Score on Head CT

Sunday, Dec. 1 12:05PM - 12:15PM Room: S501ABC

Participants
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PURPOSE

In this study, we aim to develop a deep-learning (DL) based model to automatically segment signs of ischemia acute stoke lesions on head CT scans. By implementing the topographic scoring system (Alberta Stoke Program Early Score, ASPECTs), we evaluated the performance of the proposed model in the detection of patients with acute ischemic stroke.

METHOD AND MATERIALS

For this retrospective study, over 36, 000 CT images were collected from 1,500 patients with and without ischemia stroke between 2012 and 2017. All patients had CT and MRI scan taken less than twenty-four hours apart for stroke diagnosis. The presence of Ischemia stroke lesions as well as the corresponding ASPECTS score per region were labeled on CT scans by board-certified radiologists as ground truth on the review of MRI images and clinical reports. Using CT scans as input, a DL-based model was developed by using Dense UNet as the backbone, integrating Deeplab architectures. ASPECTs score was automatically calculated individually over all ASPECTS regions for the segmentation of ischemia stroke lesions.

RESULTS

In total, scans of 346 patients including 240 patients with acute ischemia stroke and 106 patients without acute ischemia stroke lesions were used in the evaluation of the model performance. Sensitivity, specificity and accuracy rate in an ASPECTS regions-based analysis were 39.80%, 98.02% and 96.37%, respectively.

CONCLUSION

The proposed automated model demonstrated a high performance in the prediction of ischemia stoke lesions in head CT scans as well as in regions like cerebellum and brainstem.

CLINICAL RELEVANCE/APPLICATION

Our proposed model could serve as a useful tool for early diagnosis of ischemia stoke lesions and has the potential to influence clinical decisions to treat patients with thrombolysis and thrombectomy.

SSA18

Neuroradiology (Brain Tumors 1)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S401CD

MR NR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

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Sub-Events

SSA18-01 Glioma Grading Using Microstructural MRI: A Comparison of Diffusion Tensor, Diffusion Kurtosis, and Neurite Orientation Dispersion and Density Imaging

Sunday, Dec. 1 10:45AM - 10:55AM Room: S401CD

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PURPOSE

To evaluate the diagnostic performance of diffusion tensor imaging (DTI), diffusion kurtosis imaging (DKI) and neurite orientation dispersion and density imaging (NODDI) for in-vivo grading of gliomas according to the histomolecular integrated 2016 WHO classification.

METHOD AND MATERIALS

41 patients with histopathologically confirmed primary, treatment-naive gliomas (23 grade 2 and 18 grade 3-4 tumours; 10 IDH wild-type (IDHwt), 17 IDH mutant (IDHmut) 1p/19q retained and 14 IDHmut 1p/19q codeleted; 33 non-oligodendroglial and 8 oligodendroglial tumours) prospectively underwent a multi-shell diffusion-weighted protocol to assess the DTI, DKI, and NODDI-derived tumour features. Data were analysed with DKE, FSL and the NODDI Matlab Toolbox. Metric values were extracted from whole tumour segmentations and analysed by descriptive statistics and linear regression (Stata software).

RESULTS

Statistically significant differences were found for the average tumour mean kurtosis (MK) and apparent diffusion coefficient (ADC) between the IDHmut and IDHwt gliomas (p-value<=0.02); for the average MK, intra-cellular volume fraction (ficvf) and ADC between IDHmut 1p/19q retained and IDHwt gliomas (p-value<=0.04). The area under curve (AUC) was moderate (0.72-0.75) for all metrics. NODDI-derived parameters, inclunding CSF volume fraction (fiso) and ficvf showed weak significance for differentiating the IDHmut from the IDHwt gliomas (p-value 0.05-0.07) but significant differences between 1p/19q retained and codeleted gliomas (p-value 0.002).

CONCLUSION

Microstructural imaging provided satisfactory diagnostic value to differentiate IDHwt from 1p/19q retained IDHmut gliomas but only NODDI parameters could reliably probe the 1p/19q codeletion effect on the tumour microstructure in the IDHmut tumours.

CLINICAL RELEVANCE/APPLICATION

Microstructural DWI-based techniques offer complementary information for the non-invasive histomolecular WHO staging of gliomas and their combined use showed encouraging results in this pilot study.

SSA18-02 Prediction of Core Signaling Pathway using Physiologic MR Imaging Phenotypes in IDH Wild Type Glioblastoma

Sunday, Dec. 1 10:55AM - 11:05AM Room: S401CD

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PURPOSE

Radiogenomic analysis in gliomas informs multiple associations between genomic alteration and imaging phenotypes, but clinical implication for therapeutic options has been limited. This study aims to predict core signaling pathways in IDH-wild type glioblastoma for targeted therapy by exploring associations between MR imaging phenotypes and next generation sequencing (NGS).

METHOD AND MATERIALS

Genetic alterations were detected with NGS for 120 pathologically proven glioma patients who underwent multi-parametric MRI. First step found significant radiomics features for each genomic mutation using t-test with false discovery rate and lasso penalization. Second step predicted receptor tyrosine kinase (RTK), P53, and Rb pathways, with each pathway contains at least 1 relevant genetic mutation, by using radiogenomic features, age, sex, and locations using random forest and logistic regression classifier. The performance of radiogenomic modeling was tested in the independent validation set of IDH-wild type glioblastoma (n = 35) in prospective registry (NCT02619890) using area under the receiver-operating-characteristics curve (AUC).

RESULTS

First step found in 23, 19, and 29 features for EGFR, PI3KCA, and PTEN mutation in RTK pathway, 6 and 11 features for MDM2 and TP53 mutation in P53 pathway, and 3, 6, and 26 features for CDK4, CDKN2A, and Rb1 mutation in Rb pathway. The performance of core signaling pathway was AUC 0.875 (95% CI 0.743 - 1) for RTK pathway, AUC 0.757 (95% CI 0.592 - 0.921) for P53 pathway, and AUC 0.807 (95% CI 0.641 - 0.972) for Rb pathway in IDH-wild type glioblastoma. Age become significant predictor for RTK pathway.

CONCLUSION

Multiparametric MR imaging phenotypes can help characterize core signaling pathway and offers potential guidance to targeted therapy noninvasively for IDH-wild type glioblastoma.

CLINICAL RELEVANCE/APPLICATION

In this study, we included copy number variation, single nucleotide variation, and insertion/deletion to account the full width of genetic alterations causing alteration of core signaling pathway in gliomagenesis. The machine-learning based model provides individual probability of patients among three major signal pathways, including receptor tyrosine kinase (RTK), p53, and Rb pathway and allows more precise prediction to the patient-tailored targeted therapy.

SSA18-03 Lipid Fraction as a Novel Biomarker for Predicting Survival Outcome of Glioma

Sunday, Dec. 1 11:05AM - 11:15AM Room: S401CD

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PURPOSE

We evaluated the capability of MRI in-and opposed-phase (IOP) derived lipid fraction as a novel prognostic biomarker of survival outcome in glioma.

METHOD AND MATERIALS

The medical records and MRI images of forty-six histologically proven glioma (WHO Grade II to IV) patients using standard 3T MRI brain tumor protocol and IOP sequence were evaluated. Lipid fraction was derived from the IOP sequence signal-loss ratio. The lipid fraction of solid non-enhancing region of glioma was analyzed, using a three-group analysis approach based on volume under surface (VUS) of receiver operating characteristics to stratify the prognostic factors into three groups of low, medium, and high lipid fraction. The survival analysis was performed, using Kaplan-Meier survival analysis and Cox regression model.

RESULTS

Significant differences were demonstrated between the three groups (low, medium, and high lipid fraction groups) stratified by the optimal cut-off point (OCP) for overall survival (OS) ($p=<0.01$) and time to progression ($p=<0.01$). The OS plot stratified by lipid fraction also had a strong correlation with OS plot stratified by WHO grade ($R=0.61$, $p<0.01$).

CONCLUSION

The lipid fraction of solid non-enhancing region showed potential for prognostication of glioma. This method will be a useful adjunct

The lipid fraction of solid non-enhancing region showed potential for prognostication of glioma. This method will be a useful adjunct in imaging protocol for treatment stratification and as a prognostic tool in glioma patients.

CLINICAL RELEVANCE/APPLICATION

The addition of lipid fraction analysis to standard tumor protocol assessment has the potential to augment pre-treatment planning, especially focusing on intervention for the high-risk group. Future lipidomics anaylysis possible with a reliable bomarkers using IOP sequence

SSA18-04 Using Advanced DWI-MRI Parameters from Multi- B Values Acquisition and a Histogram Approach for Assessment of Early Therapeutic Response in Glioblastoma

Sunday, Dec. 1 11:15AM - 11:25AM Room: S401CD

Participants
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PURPOSE

To assess the utility of advanced quantitative diffusion MRI derived from multi b value acquisitions in the assessment of treatment response, using a spatially-independent approach.

METHOD AND MATERIALS

13 patients (7M,6F; mean age 56) were prospectively enrolled into our multicentre study. All patients had biopsy confirmed GBM and completed RT with adjuvant TMZ. Imaging was performed using a Siemens Verio (3T); pre-RT and mid RT. The MRI protocol included a 'low b value' acquisition (b= 0s/mm, 50s/mm, 150s/mm, 200s/mm, 500s/mm, 1000s/mm) from which monoexponential diffusion indices ADC and biexponential indices, IVIM parameters D*, D and f were calculated. A 'high b value' acquisition (b=0 s/mm, 500s/mm, 1000s/mm, 1500s/mm, 2000s/mm, 2500s/mm, 3000s/mm, 3500s/mm, 4000s/mm) was acquired to allow stretched exponential diffusion indices, DDC and alpha to be derived. FLAIR sequences were used to define ROI and clinical assessment of mid-treatment and end-treatment response using RANO criteria.Histograms were generated from voxels located within manually segmented ROIs defined by increased signal on T2 FLAIR images. Changes in histogram percentile profiles were evaluated across the two timepoints and compared with RANO assessment at the mid treatment and end treatment timepoints.

RESULTS

Following completion of treatment, 5 patients had PD, 4 SD and 4 CR. Patients with PD showed a histogram shift to the left across all diffusion models, in keeping with increasing diffusion restriction and implying increased cellularity. Patients with SD or CR showed little or no shift in the histogram.DDC and f are the most predictive of progression against RANO assessment, and appear superior to routine ADC. Reduction in 75th centile (f) and 95th centile (DDC) are the most sensitive histogram metrics for predicting early progressive disease.

CONCLUSION

Preliminary results suggest association between early changes in specific diffusion components and subsequent treatment response. Spatially-independent diffusion parameter comparisons provide unbiased sampling of tumour heterogeneity and abrogate the confound of voxel-to-voxel misregistration due to tumour growth/shrinkage.

CLINICAL RELEVANCE/APPLICATION

This is the first study to use advanced diffusion histogram analysis as a marker of early treatment response and can potentially identify patients who need to be swicthed to second line therapies earlier.

SSA18-05 Relationships between Shear Stiffness Measured by Magnetic Resonance Elastography and Perfusion Parameters Measured by Perfusion Computed Tomography of Meningiomas

Sunday, Dec. 1 11:25AM - 11:35AM Room: S401CD

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PURPOSE

To examine the relationships between stiffness measured by magnetic resonance elastography (MRE) and perfusion parameters.

METHOD AND MATERIALS

Twelve patients with meningiomas underwent 3D brain MRE and PCT examination before surgery. MRE was performed using a superconducting magnet operating at 3.0 T. PCT was performed on a 320-row multidetector CT scanner with rapid injection of nonionic iodine contrast media. Normalized ratios (normalized to normal white matter) of perfusion maps of cerebral blood flow (CBF), cerebral blood volume (CBV), and mean transit time (MTT) (defined as nCBF, nCBV, and nMTT, respectively) were generated. ROIs were manually drawn on the T1-weighted image coregistered into the MRE-space for stiffness map and on the enhanced-CT image for perfusion map, including the entire lesion of the meningioma. Mean values of tumor stiffness and perfusion parameters were compared by Pearson correlation. ROC analysis was used to investigate the predictive ability of perfusion parameters for firm tumors (>2.7 kPa).

RESULTS

The mean stiffness values, nCBF, nCBV, and nMTT for 12 meningiomas were 2.6 ± 3.0 kPa, 6.1 ± 3.5, 8.1 ± 5.5, and 1.2 ± 0.2, respectively. All perfusion parameters were significantly inversely correlated with stiffness values ($r=-0.6385$ to -0.7380, $p<0.0254$). The correlation between tumor stiffness and nCBV was the most marked ($r=-0.7380$, $p=0.0061$). Regarding stiffness measurement, 5 meningiomas were firm (>2.7 kPa) and 7 were non-firm. ROC analysis revealed that nCBV was a good predictor of firm tumors, with area under the ROC curve of 0.94. Using a cutoff value of >6.4, nCBV showed 100% sensitivity (5/5) and 85.7% specificity (6/7) for predicting firm tumors (fig. 1). Color-coded stiffness and nCBV maps of meningiomas in two patients are shown (Fig. 2). A firm meningioma with stiffness of 2.8 kPa in a 62-year-old woman has lower nCBV (3.4) compared with a non-firm tumor with stiffness of 2.4 kPa in a 75-year-old woman (nCBF=8.0).

CONCLUSION

We found a significant correlation between stiffness and perfusion parameters in meningiomas. In particular, CBV was a useful method for predicting a firm meningioma.

CLINICAL RELEVANCE/APPLICATION

There was a significant correlation between stiffness and perfusion parameters in meningiomas. In particular, CBV was a useful method for predicting a hard meningioma.

SSA18-06 Static and Dynamic Gallium-68-DOTATATE PET/MRI in the Diagnosis and Management of Recurrent and Progressive Intracranial Meningiomas

Sunday, Dec. 1 11:35AM - 11:45AM Room: S401CD

Participants
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PURPOSE

Meningiomas are the most common primary intracranial tumors. Contrast enhanced MRI is the gold standard for diagnosis and treatment planning, however MRI can have limited accuracy in distinguishing recurrence from treatment effect in the postsurgical and post-radiation setting. [68]Ga-DOTATATE is a PET radiotracer targeting somatostatin receptor 2 (SSTR2) with high affinity. Meningiomas express high levels of SSTR2. The purpose of our study was to evaluate [68]Ga-DOTATATE PET/MRI in a prospective clinical cohort of patients with meningioma.

METHOD AND MATERIALS

20 patients with clinically-suspected or pathology proven meningioma were imaged over a time period of 6 months. [68]Ga-DOTATATE-PET/MRI was acquired in 3D list mode over 50 minutes, beginning 5-15 minutes post injection. SUVmax values in meningiomas and suspected post treatment change were obtained, as well as the pituitary gland (positive reference) and superior sagittal sinus (SSS, background reference). In a subset of 11 patients we generated dynamic time-activity curves binned into 5-minute frames, and analyzed time-activity and time-SUVmean curves in target lesions including meningioma, post-treatment change, pituitary glands, and SSS individually as well as across the cohort.

RESULTS

A total of 50 meningiomas were identified based on PET (median: 2 per patient, range 0-14). In 17 patients PET confirmed recurrence, while in 3 patients low avidity favored a diagnosis of post-treatment change. [68]Ga-DOTATATE PET provided improved extent of disease visualization and confirmed parenchymal and osseus invasion. Dynamic PET data demonstrated unique kinetic uptake patterns for meningiomas, pituitary glands and post treatment change across the cohort.

CONCLUSION

[68]Ga-DOTATATE PET/MRI is a promising tool in the assessment of meningiomas, particularly in the post-surgical and post-radiation setting, allowing improved diagnosis and extent of disease evaluation without increasing acquisition time. Incorporating dynamic PET data acquisition and analysis can provide additional valuable information in differentiating recurrence from post treatment change, and inform future prospective clinical trials.

CLINICAL RELEVANCE/APPLICATION

In this consecutive series of 20 cases, we report a novel clinical application of combined static and dynamic [68Ga]-DOTATATE

In this consecutive series of 20 cases, we report a novel clinical application of combined static and dynamic [68Ga] DOTATATE PET/MRI in diagnosis and treatment response assessment in recurrent and progressive meningioma.

SSA18-07 Outcomes of Treatment Induced Pseudoprogression and Correlation with MGMT Methylation Status in GBM Patients

Sunday, Dec. 1 11:45AM - 11:55AM Room: S401CD

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PURPOSE

A challenge in the management of glioblastoma is distinguishing true progression from pseudoprogression (PsP), which may have improved survival. MGMT methylation has been shown to correlate with PsP. This study aims to evaluate the rates of PsP and its outcomes, and correlate to MGMT status.

METHOD AND MATERIALS

An IRB-approved retrospective study included patients with histologically confirmed glioblastoma between 2010 and 2018. All patients underwent surgical resection followed by temozolomide and radiation. Baseline pre- and post-radiation MRIs were reviewed to assess the treatment response according to RANO criteria. Maximum dimensions and volumetric evaluations were performed. Patients were graded as partial response (PR), progressive disease (PD) or stable disease (SD). Those with initial PD who had subsequent improvement without intervention were classified as PsP. We evaluated overall survival (OS) and time to progression (TTP) from the time of diagnosis, with TTP based on subsequent MRI images and clinical response, and this was correlated with the MGMT.

RESULTS

Of 101 patients diagnosed with glioblastoma, 45 had at least 9 months follow-up. The MGMT status was methylated in 7, indeterminate in 2, unmethylated in 11, and not evaluable in 22. The response was recorded as PsP in 16, PD in 12, SD in 2, PR in 12. Patients with PsP had an excellent mean TTP and OS of 327 and 545 days. The mean TTP and OS for those with PD was 250 and 450 days, and for those with PR was 446 and 676 days. Those with MGMT methylation and PsP had TTP and OS of 437 and 560 days which was similar to those with PR. Those with PsP and unmethylated MGMT had a worse mean TTP and OS of 198 and 438 days.

CONCLUSION

Patients with PsP have improved outcomes compared to those with PD or SD, with a mean TTP and OS that is between those seen with PR/CR and PD/SD. These outcomes are further improved with MGMT promoter methylation. This data substantiates prior studies' conclusions that MGMT status may significantly influence response, and patients with PsP have improved survival compared to PD/SD.

CLINICAL RELEVANCE/APPLICATION

Pseuodprogression may predict a better overall response, and recognizing it in an earlier fashion may prevent initiation of unnecessary salvage therapies that can be reserved for later in the treatment course. Interestingly, MGMT methylation has been shown to correlate with pseudoprogression and increased survival.

SSA18-08 A Single Institution Review of Primary and Secondary Imaging Characteristics of Hypophysitis in Adult Oncologic Patients Undergoing Immune Checkpoint Inhibitor Therapy

Sunday, Dec. 1 11:55AM - 12:05PM Room: S401CD

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PURPOSE

Immune checkpoint inhibitor (ICI) therapy is becoming more prevalent in the treatment of a diverse array of malignancies. With the increasing use of ICI therapy, numerous treatment related complications, termed "immune related adverse events" (irAEs), have emerged. Hypophysitis is a rare and potentially fatal toxicity requiring prompt recognition and early treatment. The purpose of this study was to identify the primary and secondary imaging characteristics of hypophysitis in patients undergoing treatment with ICIs.

METHOD AND MATERIALS

A retrospective chart review was performed of 228 adult oncology patients undergoing treatment with ipilimumab or ipilimumab and nivolumab at a single institution from 2010-2018. Primary and secondary imaging characteristics (adrenal, thyroid, uterine/ovarian atrophy) of hypophysitis were evaluated. The patients' key clinical features, labs, and patient outcomes were assessed from the medical records.

RESULTS

Hypophysitis was diagnosed in 15 (7%) of the 228 patients reviewed with a mean-onset time of 11.2 weeks (range 5-19 weeks) after initiation of ICI therapy. The mean age of diagnosis was 61 ± 16 years with 80% of the patients being male. Sixty percent of patients were treated with ipilimumab alone, and 40% with a combination of ipilimumab and nivolumab. Most patients (14) were treated for melanoma and one was treated for chondosarcoma. Imaging indications included fatigue (85%), headache (77%), and nausea (54%). Brain imaging was performed in 13 patients during and after ICI therapy. Nine patients demonstrated diffuse pituitary enlargement. Of the 9 patients, 5 demonstrated homogenous pituitary enhancement and 3 had heterogeneous enhancement on T1 post-gadolinium images). The patients were subsequently treated with steroids with a mean of 79 days until resolution of imaging findings. All patients developed adrenal atrophy and 2 (13%) had thyroid atrophy on follow up imaging.

CONCLUSION

The expanding role of ICI therapy has resulted in the increased prevalence of irAEs such as hypophysitis. The key radiological findings in hypophysitis are often subtle, but include diffuse pituitary enlargement and adrenal and thyroid atrophy.

CLINICAL RELEVANCE/APPLICATION

Hypophysitis is a rare but potentially fatal complication in oncologic patients undergoing ICI therapy. Imaging, in conjunction with clinical findings, can aid in the rapid diagnosis of the condition.

SSA18-09 Potential Imaging Biomarkers for Assessment of Treatment Response of Metastatic Brain Lesions in Patients with Small Cell Lung Cancer Using Conventional and Diffusion Weighted MR Sequences

Sunday, Dec. 1 12:05PM - 12:15PM Room: S401CD

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PURPOSE

The purpose of the study is to evaluate changes in MR characteristics of individual small cell lung cancer (SCLC) brain metastases (BMs) pre and post inital treatment following the diagnosis of BMs. The impact of these changes on CNS progression free survival (PFS) and overall survival (OS) will be assessed in an attempt to identify MR imaging biomarkers to assess response to therapy.

METHOD AND MATERIALS

In this observational study, MR characteristics of individual SCLC BMs (n=57) were evaluated pre and post treatment in 20 patients. The MRI characteristics analyzed included lesion size, T1 and T2 weighted signal, surrounding edema, hemorrhage, and diffusivity. Initial and interval changes in imaging characteristics were correlated with OS and CNS PFS. For statistical analysis, patients undergoing systemic chemotherapy only were grouped with patients receiving chemotherapy and whole brain radiation therapy (WBRT), which together (n=11) were compared to the group that received WBRT only (n=9) following the diagnosis of BMs.

RESULTS

There was statistically significant difference between the pre and post treatment means of lesion size ($p<0.0001$, Wilcoxon Signed Rank) and ADC ($p=0.0017$, Wilcoxon Signed Rank) but there was no difference across the treatment groups within pairs or among pairs. Parametric Survival analysis for OS showed statistically significant survival difference in terms of treatment type ($p <0.001$). Analysis of the MRI features of the BMs revealed that the percent increase of ADC ($p=0.0001$) was correlated with increased OS. Survival analysis showed difference between treatment groups in terms of OS ($p=0.0122$, Wilcoxon Test) but not in terms of CNS PFS ($p=0.1371$, Wilcoxon Test). There was no difference between the treatment groups in terms of percentage change in lesions size ($p=0.9405$, Kruskal-Wallis test) and percentage change in ADC ($p=0.5635$, Kruskal-Wallis test). Regarding other MRI features, there was no difference in signal characteristics including T1 signal, T2 signal and edema before and after treatment.

CONCLUSION

Changes in diffusivity from pre to post systemic chemotherapy and/or WBRT may be a useful biomarker to assess treatment response in patients with SCLC and BMs.

CLINICAL RELEVANCE/APPLICATION

The percentage change of ADC of small cell lung cancer brain metastases pre to post treatment is correlated with increased overall survival ($p=0.0001$).

SSA19

Neuroradiology/Head and Neck (Head and Neck Tumors)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S404AB

CT HN NR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

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Sub-Events

SSA19-01 Role of Apparent Diffusion Coefficient (ADC) Values in Differentiating Benign and Malignant Skull Lesions with Histopathological (HPE) Correlation

Sunday, Dec. 1 10:45AM - 10:55AM Room: S404AB

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PURPOSE

Assess the role of ADC in differentiating benign and malignant skull lesions and evaluate added value of ADC over conventional MRI alone, with HPE correlation as reference standard.

METHOD AND MATERIALS

53 patients (24 male,29 female; age 3-75years) with HPE proven skull lesions (24 malignant; 29 benign) were subjected to both conventional and DW MR imaging by using a single-shot SE EPI sequence with b-values of 0, 500 & 1000s/mm2 on 1.5T MR scanner. Margins of the lesion, number, soft-tissue component, local extension, periosteal reaction and enhancement pattern were the parameters used for differentiating benign & malignant lesions by conventional MRI. ADC values (mean of 3 ROIs over solid component) were calculated. Conventional MRI characteristics and ADC value of lesions were evaluated & compared using statistical analysis.

RESULTS

ADC cutoff value of 0.96x10-3 mm2/s obtained from ROC curve was found to have 75.47% accuracy, 87.5% sensitivity, 65.52% specificity, 67.74% PPV and 86.36% NPV for differentiating malignant from benign lesions. Statistically significant differences ($p<0.05$) were seen in the mean ADC values of malignant (0.64+/-0.42x10-3 mm2/s) and benign lesions (1.14+/-0.56x10-3mm2/s). The sensitivity, specificity, PPV and NPV in differentiating benign & malignant skull lesions were found to be 58.33%, 62.07%, 56% and 64.29% respectively, with diagnostic accuracy of 60.38% on using conventional MRI alone and 75%, 72.41%, 69.23% and 77.78% respectively, with diagnostic accuracy of 73.58% on using conventional MRI with ADC. Hence, employing ADC values in addition to conventional MR sequences improved sensitivity, specificity, PPV, NPV and diagnostic accuracy by 16.67%, 10.3%, 13.23%, 13.49% and 13.2% respectively more than conventional MRI alone. High ADC in low-grade chondrosarcoma & chordoma, low ADC in eosinophilic granuloma and variable ADC in metastases are potential pitfalls for DWI.

CONCLUSION

ADC is promising non-invasive parameter that facilitate differentiation between benign and malignant skull lesions and potentially narrow differentials when conventional imaging features are indeterminate.

CLINICAL RELEVANCE/APPLICATION

Addition of DWI & ADC to conventional MRI avoids unnecessary surgical resection, helps monitor treatment response and distinguish between post-treatment changes and recurrent skull lesions. Also it is effective method with short imaging time, thus can be incorporated into routine imaging.

SSA19-02 Exploring Radiomic Machine-Learning Classifiers Extracted from CT and MRI for Predicting the Risk of

Post-Operative Recurrence in Patients with an Advanced Squamous Cell Carcinoma of the Tongue

Sunday, Dec. 1 10:55AM - 11:05AM Room: S404AB

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PURPOSE

To identify optimal modalities and machine-learning methods for radiomics-based prediction of recurrence in advanced squamous cell carcinoma (SCC) of the tongue, treated with primary tumor resection and neck dissection.

METHOD AND MATERIALS

A total of 81 patients with advanced SCCs of the tongue (cT3-4 or any nodal metastasis), who underwent both contrast-enhanced CT and MRI (homogeneous CT/MRI scanner and protocol) for preoperative staging between 1/2010-11/2017, were enrolled in this retrospective study. All the patients were treated with primary tumor resection and neck dissection with a follow-up at least 1 year after operation (39 patients developed recurrence, and the remaining 42 did not). A total of 1409 radiomic features were extracted from each modality of CT and MRI [T2 weighted images (T2WI) and T1-weighted images using gadolinium-based contrast (Gd-T1WI)] with RadCloud platform for each patient. We used variance threshold, select K best, and LASSO algorithm to gradually select the optimal features. Computer-generated random numbers were used to assign 70% of the VOIs to the training data set and 30% of those to the validation data set for each imaging set. Classifications were made using six supervised learning classifiers (KNN, SVM, XGBoost, RF, LR, DT). ROC curve analysis was used to illustrate the prediction performance of the radiomic signature.

RESULTS

CT of 23 cases was excluded from this radiomic analysis due to metal artifacts, but MRI acquired sufficient VOIs in all the cases. For prediction of the postoperative outcome, AUC of the radiomics model based on the Gd-T1WI was the highest (0.854; 95% CI: 0.75 - 0.96, in training sets, and 0.827; 95% CI: 0.66 - 0.99, in validation sets) using KNN classifiers, compared to that using Contrast-enhanced CT (highest AUC was 0.667 in validation sets using SVM) and T2WI (the highest AUC was 0.654 in validation sets using KNN).

CONCLUSION

MRI (Gd-T1WI) may be optimum for building the radiomics model, especially using KNN methods, to predict the risk of postoperative recurrence in advanced SCCs of the tongue.

CLINICAL RELEVANCE/APPLICATION

MRI-based radiomics features could provide additional quantitative information on advanced SCCs of the tongue, which could be potentially used when considering post-operative adjuvant therapy.

SSA19-03 Exploratory Study for Identifying Predictors for Persistent Disease and Tumor Reoccurrence After Treatment of Head and Neck Cancers

Sunday, Dec. 1 11:05AM - 11:15AM Room: S404AB

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PURPOSE

Laryngeal cancer is treated with organ preservation therapy or total laryngectomy. However, little is known about which tumors will persist or reoccur after definitive therapy. The objective of our study is to investigate the feasibility of using radiomic and perfusion features as predictors to determine tumors that will persistent or recur at 1 year after treatment.

METHOD AND MATERIALS

Retrospective analysis of pre and post therapy CT neck scans was performed in 36 patients diagnosed with laryngeal cancer in this IRB approved study. Contouring of the tumors was performed by the computer and tumor features were generated on an internally developed/validated computer-aided detection (CAD) system. Twenty-six radiomic features including morphological and gray-level features were extracted from the computer. Five perfusion features including permeability surface area product (PS), blood flow (flow), blood volume (BV), mean transit time (MTT), and time-to-maximum (Tmax) were extracted from the computer. One year persistent/recurrent disease data were obtained from the time starting after the last treatment of definitive chemoradiation or after total laryngectomy surgery. We performed a two-loop leave one out feature selection using linear discriminant analysis classifier for radiomic and perfusion features. Receiver operator curves and standard deviation were generated.

RESULTS

All 36 lesions examined were primary laryngeal cancers. Out of the 36 patients, there were 10 patients (28%) that had reoccurrence/persistent disease at 1 year. Percent change in volume was the best predictive feature with an area under the curve (AUC) of 0.63 +/- 0.09. Selecting two features had a testing area under the curve (AUC) of 0.69 +/- 0.09. The best features selected were a combination of radiomic and perfusion features including percent change in volume and percent change in blood perfusion.

CONCLUSION

Our pilot study indicates that a combination of radiomic and perfusion features are good predictors of tumor reoccurrence/persistent disease after treatment with definitive radiation or total laryngectomy. Our next step is to expand our data set with additional patients.

CLINICAL RELEVANCE/APPLICATION

Predicting tumors that will reoccur or persist after traditional treatments is an important tool for head and neck cancer management. Good predictors can help providers determine prognosis and patients decide between therapeutic options.

SSA19-04 Diagnostic Performance of Post-Treatment Response Assessment FDG PET/CT Using NI-RADS in Head and Neck Cancer

Sunday, Dec. 1 11:15AM - 11:25AM Room: S404AB

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PURPOSE

To assess the diagnostic performance of response assessment FDG-PET/CT following definitive (chemo)radiotherapy in head & neck cancer using Neck Imaging Reporting and Data System (NIRADS).

METHOD AND MATERIALS

Pre and post-treatment response assessment FDG-PET/CT scans of 146 patients with squamous carcinoma of oropharynx & laryngo-pharynx prospectively treated with image-guided intensity modulated radiation therapy were compared and classified as per NI-RADS template. NI-RADS category 1 indicates no evidence of recurrence; category 2 suggests low suspicion of recurrence; category 3 suggests high suspicion of recurrence; and category 4 is known or proven recurrence. The diagnostic performance of NIRADS criteria was evaluated using pathologically proven loco-regional recurrence as the reference standard.

RESULTS

For disease at primary site, 67%, 25% and 8% patients were scored as NI-RADS 1, 2 and 3 respectively. For NI-RADS 1 category at primary site (n=98), the rate of local recurrence within 2 years of therapy was 20.4% with a specificity of 100% and negative predictive value (NPV) of 79.6%. Rate of local recurrence for NI-RADS 2 and 3 were 38.8%, and 83% respectively. For neck nodal disease, 78%,10% and 12% patients were scored as NI-RADS 1, 2 and 3 respectively. For NI-RADS 1 category in the neck (n=114), rate of neck nodal recurrence within 2 years of therapy was 21% with a specificity of 100% and NPV of 80%. Rate of nodal recurrence for NI-RADS 2 and 3 were 53.3%, and 70.5% respectively. There was a strong association between NIRADS score and loco-regional disease status ($p<0.001$).

CONCLUSION

There is a strong association between NI-RADS score and loco-regional disease status in head and neck cancers. Although the specificity of NI-RADS 1 is excellent, its NPV is suboptimal precluding adoption in routine clinical practice.

CLINICAL RELEVANCE/APPLICATION

There is a strong association between NI-RADS score and loco-regional disease status and is recommended as a part of post treatment response assessment FDG PET/CT in head and neck cancers.

SSA19-05 Inter-Radiologist Reliability of NI-RADS on Post-Treatment PET/CECT in Head and Neck Squamous Cell Carcinoma

Sunday, Dec. 1 11:25AM - 11:35AM Room: S404AB

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PURPOSE

The Neck Imaging Reporting and Data System (NI-RADS) was developed as a standardized reporting template for head and neck squamous cell carcinoma (HNSCC) surveillance. Previous studies have demonstrated the utility of FDG-PET/contrast-enhanced CT (PET/CECT). A NI-RADS category between 1 and 4 is assigned to the primary tumor and nodal site independently to convey the degree of suspicion for disease as well as provide management recommendations. Our purpose was to evaluate the inter-rater reliability among radiologists examining posttreatment HNSCC PET/CECTs using NI-RADS.

METHOD AND MATERIALS

Eighty HNSCC patient cases were uploaded to the American College of Radiology Cortex, with pre- and posttreatment PET/CECT studies. All images were scrubbed of all identifying information prior to upload. Each case provided a brief history of the patient, including age, sex, location of primary, staging, treatment, and timing of scan. Eight radiologists (5 neuroradiologists specialized in H&N, 1 general neuroradiologist and 2 neuroradiology fellows) independently evaluated each case and answered 4 multiple choice questions regarding the radiologic appearance of any primary or nodal disease and its associated NI-RADS category. Intraclass correlation coefficients (ICC) were calculated to assess inter-rater agreement.

RESULTS

The overall ICC for all readers for the primary site NI-RADS score (NS) was 0.58 (95% CI = 0.50 - 0.67) and for the nodal site NS was 0.65 (95% CI = 0.55 - 0.74). Among subspecialist readers, the ICC for the primary site NS was 0.61, and for the nodal site NS was 0.62. Non-specialists had an ICC of 0.55 for the primary site NS and 0.72 for the nodal site NS. The maximum pairwise kappa value was achieved between two specialist readers from different institutions who had never trained together, with an ICC of 0.72 for the primary site NS.

CONCLUSION

There was moderate agreement among the eight radiologists using NI-RADS in posttreatment HNSCC surveillance imaging. Disagreement among raters highlights the importance of training and standardization in the interpretation of post-treatment head and neck cancer surveillance imaging.

CLINICAL RELEVANCE/APPLICATION

This is the first study to examine the inter-rater reliability of NI-RADS, a standardized reporting template used in posttreatment HNSCC surveillance PET/CECTs.

SSA19-06 Implementing ACR-TIRADS to Improve Thyroid Nodule Reporting and Management

Sunday, Dec. 1 11:35AM - 11:45AM Room: S404AB

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PURPOSE

The ACR Thyroid Imaging Reporting and Data System (TIRADS) was recently indroduced in 2017 as a white paper in order to standardize the reporting of thyroid nodules. The purpose of this project was to implement ACR TIRADS at a regional medical system and evaluate thyroid ultrasound reporting before and after implementation with the goal of improving the consistency of nodule descriptor usage to aid in giving reffering providers an appropriate recommendation for follow-up. Another goal was to decrease the number of unesessary fine needle aspirations.

RESULTS

During 2017, 200 thyroid ultrasound studies were perfomed. Of these, 140 demonstrated one or more nodules. The TIRADS descriptors addressing nodule composition, echogenic foci, margin, and shape were only utilized 14-34% of the time. Echogenicity was used as a descriptor 90% of the time. Level of suspicion regarding regarding these thyroid nodules (i.e. benign or mildly/moderate/highly suspicious) was only utilized in a total of 12% of the reports. Recommendations for management including fine needle aspiration (FNA), surveillance, or benign/no further imaging was given 61%, 24%, and 9% of the time respectively. 6% of the studies with nodules were given no recommendation. 40 FNAs were performed (47% of recommended FNAs). A total of 9 biopsy-proven cancers were detected, representing 10.5% of all recommended FNAs and 22.5% of FNAs performed. During the 6 month study period following formal TIRADS reporting implementation, 103 Thyroid ultrasounds were performed. Of these, 77 demonstrated one or more nodules. 4 of the TIRADS descriptors (echogenicity, composition, echogenic foci, and margin) were utilized in 86-100% thyroid ultrasound reports. Shape was mentioned in 78% of studies, increased from 14%. Level of suspicion regarding regarding these thyroid nodules (i.e. not/mildly//highly suspicious) was utilized in a total of 19% of the studies. Recommendations for management including FNA, surveillance, or benign/no further imaging was given for 35%, 34%, and 18% respectively. 10% of the studies with nodules were given no recommendation. 12 of the recommended FNAs were performed (44% of recommended FNAs). A total of 2 biopsy or thyroidectomy-proven cancers were detected, representing 7.4% of all recommended FNAs and 16.7% of FNAs performed.

CONCLUSION

The implementation of ACR-TIRADS resulted in an improved consistency of thyroid nodule description with an overall decrease in the number of recommended FNAs. This shows that by having a system to help radiologists stratify nodule risk based on a set parameter of characteristics, more appropriate recommendations can be made to guide referring providers. A limitation to our follow-up data collection resulted from patients being lost to follow-up or following-up outside our hospital system and is a possible explanation for the low percentage of recommended biopsies being perfomed. Additional limitations included adoption of the new reporting style to some of the senior attending radiologists and the frustration some reffering providers voiced due to the increased length of the reports. The senior radiologists eventually adapted to the new style and began using it more regularly. Following the study period of TIRADS implementation, the TIRADS templates have been further revised to increase ease of interpretation for our referring clinicians while maintaining the consistency of TIRADS usage.

METHODS

Thyroid ultrasound reports for exams completed before the implementation of TIRADS reporting at the participating institution were reviewed for use of TIRADS nomenclature from 1/1/2017-12/31/2017. A standardized TIRADs template was created for the participating radiologists to ensure accurate, consistent, and appropriate use of TIRADS descriptors and recommendations post implementation from 4/1/2018-9/30/2018. Additionally, a TIRADS worksheet was developed for participating ultrasonographers, and these ultrasonographers were educated in the purpose and usage of the TIRADS criteria. Comparison was made between pre and post implementation usage of the 5 TIRADS nodule descriptors and follow-up recommendations. The hospital EMR was used to obtain information on patient follow-up and mangement by the reffering provider.

SSA19-07 Effect of Ti-Rads Standardized Reporting Calculator on Radiologist Report Consistency and Recommendation for Thyroid Nodules Management

Sunday, Dec. 1 11:45AM - 11:55AM Room: S404AB

Participants
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PURPOSE

Thyroid nodules are a common imaging finding. Though the majority of are benign, there is overlap in the imaging appearance of benign and malignant nodules. Various systems have been published to guide radiologists for their appropriate management; till recently our practice utilized the 2015 American Thyroid Association (ATA) guidelines for this purpose. Though helpful, the use of this system as inconsistent, with anecdotally high biopsy recommendation rates and an inability to classify some nodules making it difficult to provide specific recommendations. We recently adopted the American College of Radiology (ACR) Thyroid Imaging, Reporting, and Data System (TI-RADS), a newly-developed standardized system employed to unify lexicon and management recommendations for the ultrasound evaluation of thyroid nodules. In addition, a web-based calculator (Figure 1) that standardizes language, tallies scores and generates recommendations was implemented to streamline reporting and ease utilization of this system. The purpose of this project was to report effects of radiologists' adherence to and reported recommendations before and after the adoption of ACR TI-RADS criteria at a large, multi-site academic practice.

RESULTS

We reviewed the data for radiologist adherence to the department approved recommendations (ATA vs TI-RADS), the rate of providing specific recommendations and compared the specific recommendations provided (biopsy vs follow-up vs no follow-up) before and after TIRADS adoption. Brief demographics of the final database were: 1651 studies with 2017 individual nodules. Of the 1651 patients, 1234 were female, comprising 75.7% of cases. Our outcomes were that 10.8% of nodules evaluated by TI-RADS were reported without a recommendation compared to 48.7% of nodules that used ATA and 63.8% that used No Scoring System (Table 1). With our intervention, the rate for appropriate recommendations was 86.1% for TI-RADS, 44.3% for ATA and 30.3% for when No Scoring system was utilized (Table 2).

CONCLUSION

The aim of the study was to implement TI-RADS as the departmental standard guideline for assessment of thyroid nodules on ultrasound to improve standardized reporting, guideline adherence, and the rate of providing actionable recommendations for reported thyroid nodules. Standardization in reporting lexicon and management recommendations was more prevalent when a radiologist was using TI-RADS along with a web based calculator. 10.8% of nodules evaluated by TI-RADS were reported without a recommendation compared to 48.7% of nodules for ATA and 63.8% with No Scoring System, 37.9% less than the next closest system. In addition, based on our intervention, an increase in the reporting of appropriate management was significant for the TI-RADS scoring system compared to ATA and No Scoring System as it was 41.8% more than the next closest system. By having definitive recommendations established and consistent reporting of these recommendations, future patient care decisions can be made much more quickly and consistently, probably resulting in improved patient outcomes.

METHODS

Prior to its adoption, TI-RADS was internally reviewed by key radiology leaders and referring specialists including surgical endocrinology, discussed in department wide educational meetings including a journal clubs. The web-based calculator was created to streamline reporting, with a link embedded in the reporting templates. A "go-live" date was announced, at which point the system reporting templates were changed over to the new application. A power analysis was done with the basis on a change of yield of malignancy from 10 to 14%. It was concluded a minimum of 200 cases were needed before and after the "go-live" date. To determine the effectiveness, data for all US Thyroid, Neck and Soft Tissue and FNA report narratives was extracted. These 6283 cases were then semi-automatically parsed for Thyroid cases (non-procedural) using keyword identification within our structured reports, resulting in 1651 examinations. These exams were then manually reviewed and relevant data (patient and imaging) were recorded. We assessed adherence to utilizing the standard guidelines, whether a specific recommendation was made: either biopsy, follow up, or no follow up needed and if it was appropriate.

SSA19-08 Participants

Modified SHIN Classification for Grading Trachea Invasion on CT Imaging: Addressing the Resectability Issues in Thyroid Cancer

Sunday, Dec. 1 11:55AM - 12:05PM Room: S404AB

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PURPOSE

Evaluate the diagnostic value CT based modified SHIN Classification adapted from pathological SHIN grading for preoperative prediction of Tracheal invasion (TI) in patients with papillary thyroid cancer (PTC).

METHOD AND MATERIALS

Retrospective study from Jan 2012 to Dec 2016, 104 PTC patients who underwent total thyroidectomy were analysed. Preoperative CT were performed in all. TI was categorised based on contact of tumour with trachea on CT imaging. Grades of CT based SHIN Classification: I: disease abuts not invading external perichondrium. II: disease invades into the cartilage +/- destruction. III: disease extends into the tracheal mucosa with no elevation/penetration of mucosa. IV: disease is full-thickness invasion with expansion of the tracheal mucosa with a bulge. Other imaging features were: Angle of contact: grade I:0-89; II 90-179; III:180-269; IV:>270 Shape Score: I: horseshoe, elliptical, circular configuration; II: locally straightened wall; III: inward concave deformity. Grade of enhancement: None, similar, hyperenhancement Considering histopathology as the gold standard diagnostic performance of CT imaging for predicting TI.

RESULTS

84 patients (19 men, 65 women), 97 lesions (one tumor in 71 patients and two tumors in 13 patients). Mean maximum axial diameter of lesions was 3.5 ± 1.5 cm (one SD), ranging from 1.1 to 8.4 cm.CT based SHIN categories I- 39%, II- 25%, III- 21% and IV- 15%. More than 130-degree contact with trachea, soft tissue within the cartilage and score III shape were strong predictor of TI (P value < 0.05). Of the three factors, soft tissue in the cartilage was most accurate, 88% accuracy with 79% sensitivity. Intraluminal mass showed 100% specificity, the sensitivity was low 28%. SHIN showed good accuracy 93% with upwards of 90% sensitivity and specificity. Modified shin classification combined had a 96% accuracy.

CONCLUSION

CT based Modified SHIN classification has a very high negative predictive value for predicting TI and can help optimizing postoperative outcomes with efficient preoperative assessment.

CLINICAL RELEVANCE/APPLICATION

Presence Tracheal invasion (TI) alters the management plan. extensive local resection can improve survival rate and reduce local recurrence Vs. near-total tumor excision with adjuvant treatment has survival rate similar to that obtained with extensive resection Hence, assessment of extent of TI with pre-op imaging is crucial in appropriate treatment planning.

Printed on: 10/29/20

SSA20

Physics (Radiation Dose - Radiography/Fluoroscopy)

Sunday, Dec. 1 10:45AM - 12:15PM Room: E351

PH SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Virgina Tsapaki, PHD, Nea Ionia, Greece (*Moderator*) Nothing to Disclose
Adam S. Wang, PhD, Baltimore, MD (*Moderator*) Research support, General Electric Company; Research support, Siemens AG; Research collaboration, Varex Imaging Corporation; Stockholder, Varian Medical Systems, Inc

Sub-Events

SSA20-01 Cohort Study of Patients Receiving Substantial Cumulative Doses from Fluoroscopically-Guided Interventional Medical Procedures Over 9 Years

Sunday, Dec. 1 10:45AM - 10:55AM Room: E351

Participants
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PURPOSE

Fluoroscopically-guided interventional (FGI) procedures deliver the highest radiation dose among all imaging procedures. This study is to explore the medical conditions of patients receiving 1-year cumulative Ka,r (air kerma at the reference point) >= 5 Gy or effective dose >= 100 mSv from FGI procedures over 9 years.

METHOD AND MATERIALS

With IRB approval, this retrospective study examined 25253 patients (average age 58.2±17.0 years, 50.6% male) who underwent 46491 FGI procedures at a tertiary referral center from January 2010 to January 2019. Data was retrieved from an in-house semiautomated dose tracking system by setting the above dose thresholds. Identified patients were characterized by medical conditions documented in longitudinal medical records. Statistical software (R, version 3.5.1) was used to determine 5 percentiles (10th, 25th, 50th, 75th, 95th) and interquartile range (IQR) of age and dose distributions.

RESULTS

Among 411 (1.6%) patients (68.6% male) with 1-year cumulative Ka,r>=5 Gy, median number of FGI procedures was 3 (range 1-34), median age at the first procedure was 59 (IQR 48-68) years, median value of 1-year cumulative Ka,r was 7047 (IQR 5755-9066) mGy, and median effective dose was 260 (IQR 142-369) mSv. Among1011 (4.0%) patients (69.6% male) with effective dose>=100 mSv, median number of FGI procedures was 2 (range 1-38), median age at the first procedure was 60 (IQR 51-69) years, median value of 1-year cumulative Ka,r was 3899 (IQR 2785-5727) mGy, and median effective dose was 177 (IQR 132-261) mSv. Patient medical conditions included trauma, stroke/brain aneurysm, medical bleeding in torso, organ transplant, cancer, benign tumor, and chronic disease. Five of 22 patients with 1-year cumulative Ka,r>=15 Gy deceased as of March 2019.

CONCLUSION

This is a first cohort study of patients receiving substantial cumulative doses from FGI procedures over a long period, revealing the use of substantial dose in the critical care of a sizeable fraction of patients under serious medical conditions. The provided cumulative dose distributions can serve purpose for dose management.

CLINICAL RELEVANCE/APPLICATION

X-ray fluoroscopy guidance can save lives in urgent or critical care of patients under serious medical conditions, and the care of 1.6%-4.0% patients may use substantial dose (1-year cumulative Ka,r>=5 Gy, or effective dose>=100 mSv).

SSA20-02 Source of Errors in Indirect Fluoroscopy Skin Dose Estimation and Peak Skin Dose Position

Sunday, Dec. 1 10:55AM - 11:05AM Room: E351

Participants
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PURPOSE

There has been an increasing shift to using dose monitoring software for tracking skin exposure during fluoroscopically-guided interventions. It was reported that indirect skin dosimetry is unlikely to be more accurate than +/-50%, while others reported that compared to direct measurements, the error can be within +/-20%. This study is to identify the source of errors and demonstrate their potential influence on the accuracy of indirect dose estimation.

METHOD AND MATERIALS

We analyzed available indirect skin dose methods using varying levels of procedural details in the patient protocol and identified potential source of errors, including but not limited to gantry angle, source-surface-distance (SSD), table-pad attenuation, and backscatter. Simple algebraic approach was applied to analyze the effects of those such as distance and attenuation, while Monte Carlo was used to simulate the effects of gantry angles (primary & secondary) combing with various field of view (FOV). We also did direct distance and attenuation measurements from a Philips Allura Xper FD10 for quantitative analysis.

RESULTS

Gantry angle shows the largest impact on the magnitude and position of peak skin dose (PSD). Simulation shows that PSD location shifts ~18cm from center with the gantry angle from 0° to 50°, independent of FOV. The ratio of PSD to reference air kerma increases from 1.2 to 1.6 (for gantry angle 0°) and from 1.38 to 1.90 (for gantry angle 40°), with the increased FOV from 5 cm to 40 cm. Both the magnitude and position of PSD with gantry angle show non-linear relationship, which increases the difficulty to accurately estimate skin dose. The simple SSD increase due to the use of the pad (in general not considered) may add up to 18% error in dose, based on its thickness and patient weight. The ratio of the exposure with pad-table to air kerma varies up to 15% as kV increase from 50 to 120 kV due to attenuation, plus about 20% backscatter changes (depending on FOV) due to increased beam energy. The use of an additional Cu filter will aggravate the results, i.e., an additional 0.2mm Cu filter can add ~5% more error in PSD estimate. .

CONCLUSION

Understanding the source of errors in indirect skin dose estimates will improve accuracy of the PSD estimation which determines notification level.

CLINICAL RELEVANCE/APPLICATION

Improving the accuracy of PSD estimation can potentially reduce unnecessary notifications or avoid missing notifications.

SSA20-03 Comparison and Image Evaluation of Mini C-Arm Fluoroscopy System Based on Cold Cathode and Hot Cathode

Sunday, Dec. 1 11:05AM - 11:15AM Room: E351

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PURPOSE

In this study, we qualitatively and quantitatively compared and analyzed the X-ray images obtained from the carbon nanotube (CNT) based cold cathode and tungsten based hot cathode ceramic tubes integrated together in mini C-arm fluoroscopy system.

METHOD AND MATERIALS

A commercialized portable type mini C-arm fluoroscopy system (figure a) was constructed with sealed ceramic type cold cathode and hot cathode X-ray tubes (figure c) and a flat panel detector (RAD icon, 0889, Teledyne Rad-icon Imaging Corp., CA, USA). We developed the CNT emitter and the brazed X-ray tubes at our own lab which can work at high anode voltage without arcing. We demonstrated the superiority of CNT based cold cathode (figure e) X-ray sources over thermionic (figure d) counterpart in terms of producing high resolution X-ray images, pulse based active control switching and quantity of radiation dose. X-ray images of alive rat (figure f) and resolution phantom was taken to compare and evaluate the images from both X-ray sources. Herceptin drug was inserted into a live rat to produce cancer cells and detect it through X-ray images from different sources. Imaging was done at various pulses to evaluate the efficiency of converting the digital signals for switching and calculate the radiation dose.

RESULTS

CNT based cold cathode X-ray source showed the 20% less radiation to produce the same quality image with the same exposure time. Cold cathode source had 40% smaller focal spot size compared to hot counterpart. The response to digital pulses was 3 times faster in CNT based cold cathode than hot cathode X-ray sources. Finally, the X-ray images obtained at 80 kV with 1mA anode current exposed, the optimal voltage to take high quality image of rat to detect cancer cells from normal tissue.

CONCLUSION

CNT based cold cathode source in Mini C-arm fluoroscopy system showed better functions, superior quality X-ray Image and safer (reduced radiation dose) compared to the hot cathode X-ray source.

CLINICAL RELEVANCE/APPLICATION

Imaging quality can be greatly improved by CNT based cold cathode source with lower radiation dose and greatly improved the imaging techniques by integrating the digital signals.

SSA20-04 The Effect on the Scattered Radiation Distribution of Moving the Centerline of the Patient Lateral to the X-Ray Beam Isocenter During Fluoroscopic Procedures

Sunday, Dec. 1 11:15AM - 11:25AM Room: E351

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PURPOSE

The scattered radiation from the patient reaching the interventionalist changes as the patient table is moved left and right of the c-arm gantry isocenter. This study investigates and quantifies the change in the scattered radiation dose distribution as the patient is moved laterally.

METHOD AND MATERIALS

EGSnrc (DOSXYZnrc) Monte-Carlo software was used to calculate the scattered radiation distribution around the Zubal anthropomorphic computational phantom of an average adult male for beams imaging the head, the chest and the abdominal regions. The distributions were calculated as a function of the lateral shift of the phantom from the c-arm isocenter for x-ray beams with different gantry angulation. All comparisons were made with the same exposure factors and each MC simulation used 3E9 primary beam photon histories.

RESULTS

For staff at a fixed distance from the isocenter, the scatter was generally reduced as the patient was moved toward the staff, since in this case the body attenuates more of the scatter, and it conversely increased as the patient is moved away from the staff. The percent differences from the centered patient when averaged over distance from the floor with a PA projection for staff on the right side were: Head, 2.4 cm shift to left, 48% increase; 2.4 cm shift to right, 37% decrease; Chest, 5 cm shift to left, 133% increase; 5 cm shift to right, 54% decrease; Abdomen, 2.5 cm shift to left, 127% increase; 2.5 cm shift to right 47% decrease. The change in scatter with shift for different LAO/RAO and CRA/CAU angles was similar. For zero degrees RAO/LAO chest projections with the patient centered, the scattered dose on the left side was lower than the right side due to differences in internal organ attenuation.

CONCLUSION

During Interventional procedures, only small table lateral movement can substantially impact the scattered dose to the staff in the room. Such changes in scatter is dependent on height from the floor and will have an effect which is dependent on where the staff is located in the room. The information from this study provides a better understanding of the changes in scattered dose distribution and facilitates improved staff dose management.

CLINICAL RELEVANCE/APPLICATION

The position of the x-ray beam relative to the patient centerline has a substantial effect on the room scatter distribution and this information can help staff manage their dose.

SSA20-05 Radiation Doses to Patients from Fluoroscopically-Guided Liver Procedures

Sunday, Dec. 1 11:25AM - 11:35AM Room: E351

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PURPOSE

To present procedure-specific distributions of air kerma at the reference point (Ka,r) and effective dose for fluoroscopically-guided liver procedures.

METHOD AND MATERIALS

With IRB approval, this retrospective study included 1090 consecutive liver cases (61.6% male) performed from May 2016 to October 2018 in adults. Patient age at the procedure time was 60.8±13.0 years for the men (median 63 years, range 22-93 years, 17.4% in 22-50 years) and 58.7±15.3 years for the women (median 62 years, range 20-90 years, 27.4% in 20-50 years). Ka,r and dose-area product (KAP) were retrieved from an in-house semiautomated dose monitoring system. Effective dose was calculated using KAP and a conversion coefficient [0.26 mSv/(Gy.cm2)] from NCRP Report No. 160. Statistical software (R, version 3.5.1) was used to determine 5 percentiles (10th, 25th, 50th, 75th, 95th) for 9 procedures - endovascular liver biopsy, transjugular intrahepatic portosystemic shunt (TIPS) creation, TIPS revision, pre-selective internal radiation therapy (SIRT), SIRT, hepatic artery embolization, transarterial chemoembolization, portogram, and portal vein embolization.

RESULTS

Number of procedures was 239, 120, 79, 184, 187, 37, 186, 32 and 26; Median Ka,r was 102, 886, 317, 615, 245, 1202, 907, 502 and 1009 mGy; median effective dose was 5.44, 56.1, 19.1, 37.2, 13.3, 48.1, 49.7, 26.9 and 47.1 mSv; ultrasound guidance usage was 99.6%, 97.5%, 91.1%, 17.4%, 19.3%, 56.8%, 22.0%, 87.5% and 96.2% for 9 procedures (in the above order), respectively. Among all cases, the lowest Ka,r was 8 mGy for a male (age 63 years, weight 73 kg) from endovascular liver biopsy under both ultrasound guidance and x-ray fluoroscopic guidance. The highest Ka,r was 11121 mGy for a male (age 65 years, weight 79 kg) from hepatic artery embolization. Effective dose range was 0.4-303 mSv.

CONCLUSION

In interventional liver procedures, ultrasound guidance is used when feasible to reduce patient dose. This is a first study to provide both Ka,r and effective dose for comprehensive liver procedures under fluoroscopy and/or ultrasound guidance.

CLINICAL RELEVANCE/APPLICATION

With the Joint Commission's standard of fluoroscopy dose review, 5 percentiles of Ka,r and effective dose provided in this study for 9 liver procedures can be used to set baselines in dose management.

SSA20-06 Radiation Exposure to Pediatric Patients and Staff During Retrograde Wedge Portography

Sunday, Dec. 1 11:35AM - 11:45AM Room: E351

Participants
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PURPOSE

Most recent surgical procedures such as the meso-Rex bypass shunt requires wedged hepatic venous portography via the transjugular approach for the assessment of the surgical patient. Retrograde Wedge Portography (RWP) is an interventional procedures performed on patients with portal vein cavernoma in cases where the Rex Recessus is not well delineated with the other non-invasive imaging techniques. Usually staff radiation doses during pediatric interventional procedures are associated with a lower occupational radiation risk because the patients are small. However patient radiation doses may be high particularly when the abdominal region is involved; pediatric procedures require the operators to be physically close and, as when transjugular approach occurs, it is often not possible to use protective screens and some more complex case also can result in a longer fluoroscopic time. These can result in increased operator doses. It is well known that a good radiation protection program in daily practice for all procedures reduces radiation risks to patients and staff and electronic dosimeters have proven to be useful for optimization purposes, for studies of radiation exposure by type of procedure or for specific aspects of a procedure. Our study aim is to provide data on radiation exposure to pediatric patients undergoing RWP and effective dose (E) of each operator performing them in a single center using a pediatric adjusted fluoroscopy protocoln in a flat-panel detector based system (FPDS).

RESULTS

Tube voltage range was 60-84 kV; Tube current range was 0.1-9.5 mA; Spectral filtration was 0.3 mmCU. Patients: mean DAP was 11.2±12.9Gy*cm2 (3rd quartile 11.9Gy*cm2); mean KA was 0.16±0.09Gy (3rd quartile 0.2Gy); mean FT was 357±181sec (3rd quartile 420sec). Staff: mean E for the radiologist was 0.50±0.46μSv (3rd quartile 0.75μSv); for the radiographer 0.12±0.11μSv (3rd quartile 0.18μSv); for the anesthesia nurse 0.08±0.17μSv (3rd quartile 0.03μSv). Figure 1 shows the mean E for all operators. Figure 2 shows the operators' positions within the angiosuite during hepatic RWP.

CONCLUSION

In conclusion, this study demonstrated that the radiation doses to the operators in RWP can be very low, remaining well within limits established by the ICRP. The difference in dose among all operators, is related to their position within the angiosuite in relation to the angiographic equipment. Operators performing RWP should be aware of the potential high radiation exposure for themselves and for patients too. Good radiation protection policies and training are necessary in interventional radiology to reduce radiation risks to both patients and staff. No other data about radiation exposure to pediatric patients and staff performing RWP are in the available literature to compare our results. However, in our experience, close liaison between radiologist and radiographer allowed us to vary technical parameters and to select a different fluoroscopy protocol from the pre-set provided by the manufacturer. Although this may have resulted in a small variation in image quality, procedures included in this study were performed safely. New technologies and in-depth knowledge of angiographic equipment can help us to achieve a low radiation dose to patients and staff according to the RWP procedure complexity.

METHODS

Between September 2016 and December 2018, 19 consecutive RWP were performed on 19 children (mean age 7±5 years, 3rd quartile 11.5 years). Two Radiologist, six radiographers and six anesthesia nurses were involved in this study. A pediatric fluoroscopy protocol optimized to produce high contrast images using 50% as threshold dose with modified parameters adjusted on

pediatric patients, 7.5 frame/sec and low image detail level was routinely employed. Magnification and normal image detail level was only used when absolutely necessary in technically challenging cases. Digital Subtraction Angiographic acquisition (DSA) was used during which all operators left the angiographic suite and went into the control room while images were acquired. Electronic personal dosimeters, placed outside the lead apron at the left upper chest position, were used to measure radiation doses to radiologist, anesthesia nurse and radiographer. Due to the transjugular access, no additional shielding was used for the interventional radiologist. The Hp(10), the personal dose equivalent at a depth of 10 mm of tissue, registered by the detectors at the end of every procedure was systematically recorded. Effective operator dose (E) was then calculated using a modified Niklason algorithm, by multiplying the Hp(10) value by 0.03, and given in µSv. Patients' radiation exposure was measured with Dose Area Product (DAP) and fluoroscopy time (FT). Descriptive statistics (mean ± SD and third quartile) of the dose area product (DAP, given in Gy*cm2), air kerma (KA, given in Gy) and fluoroscopy time (FT, given in seconds) for each procedure were recorded

SSA20-07 Clinical Evaluation of a Dose Management System-Integrated 3D Skin Dose Map by Comparison with XR-RV3 Gafchromic® Films

Sunday, Dec. 1 11:45AM - 11:55AM Room: E351

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PURPOSE

Validate the performance of peak skin dose (PSD) and skin dose map (SDM) estimation from a radiation dose management system (RDMS) (DoseWatch™, GE Healthcare) versus the gold standard of XR-RV3 Gafchromic film in interventional vascular and cardiology procedures.

METHOD AND MATERIALS

The study was conducted on a total of 38 cardiac procedures and 60 vascular embolizations between June 2018 to March 2019 on three Philips systems (two Allura Xper FD10 and one Allura Xper FD20). 'Ground truth' PSD measurements (PSDFilm) and spatial dose distributions were obtained from XR-RV3 Gafchromic film, positioned underneath patients' backs for each procedure. These were compared against PSDRDMS and SDMRDMS estimates provided by the dose management system using a triangle mesh of 0.055cm² resolution on ICRP 110 anthropomorphic phantoms, as well as on a planar phantom with a square ROI of 1cm². The RDMS used Radiation Dose Structured Report (RDSR) data to model exposure events, calculating PSD following the methodology described by K. Jones, et al. Statistical analyses were carried out to compare PSDFilm and PSDRDMS.

RESULTS

Preliminary results show that the PSDFilm median (1st quartile; 3rd quartile) was 0.573(0.411; 0.981) Gy for vascular procedures and 0.443(0.297; 0.700) Gy for cardiac procedures. For a flat phantom, the PSDRDMS was 0.553(0.375; 1.031) Gy for vascular procedures and 0.467 (0.311; 0.708) Gy for cardiac procedures, and 0.583(0.388; 1.097) Gy and 0.440 (0.305; 0.750) Gy for anthropomorphic phantom, respectively. For both phantoms, the correlation between PSDFilm and PSDRDMS was strong. For vascular procedures, the mean deviation between PSDFilm and PSDRDMS was 1 ± 16% for flat phantom and 2% ± 19% for anthropomorphic phantom and 5 ± 19% and 2 ± 18% for cardiac procedures, respectively. Dose map representations matched for most patients. Gaps identified are related to the table displacement during fluoroscopy events and the use of a wedge filter.

CONCLUSION

The results found in this patient study show that SDM tool is a suitable alternative to Gafchromic® film to calculate PSD and visualize the skin dose distribution.

CLINICAL RELEVANCE/APPLICATION

The RDMS tool can be used routinely to compute the PSD for all patients with an accuracy close to the one of Gafchromic films, effectively reducing costs and complexity of patient follow-up

SSA20-08 Radiation Dose Audit for Fluoroscopy Procedures Performed with Mobile C-Arms or Performed in Radiography/Fluoroscopy (R/F) Suites: Data From a Tertiary and Quaternary Care Hospital

Sunday, Dec. 1 11:55AM - 12:05PM Room: E351

Participants
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Jaydev K. Dave, PHD, Philadelphia, PA (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV Equipment support, Lantheus Medical Imaging, Inc Equipment support, General Electric Company

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CONCLUSION

Data indicates that with mobile C-Arms or R/F suite, radiation utilization for routine procedures is an order of magnitude lower relative to threshold radiation dose values recommended for patient follow-up. Monitoring such low radiation dose values may not be optimal use of healthcare resources. Alternately, evidence-based exemption should be granted from the requirement of tracking

fluoroscopy doses for such low dose procedures.

Background

Accreditation agencies necessitate documenting radiation doses for fluoroscopy procedures. Our hypothesis was that procedures performed with mobile C-Arms or in R/F suites utilize radiation dose levels considerably below the recommended threshold for patient follow-up based on possibility of tissue reactions.

Evaluation

IRB waiver was obtained. All fluoroscopy procedures performed with any one of the 14 mobile C-Arms (GE:OECs, Philips:Veradius, Ziehm:Vision-R) or in an R/F suite (Siemens:Axiom-Iconos-200) from July-2017 till June-2018 were reviewed. Mobile C-Arms were used for surgical, orthopedic, pain-management, gastroenterology and urology procedures. All cases with system-reported cumulative air kerma (CAK) were included in the study. Descriptive statistics were computed from this data-set to characterize radiation utilization.

Discussion

Data from 1122 cases were included (53% female/47% male; age:53.9±17.9years; BMI:28.4±6.7). The mean (±standard deviation) and median CAK values for radiology procedures (n=102; e.g., arthrograms, aspirations, etc.) performed with mobile C-Arms were 16.5(±54.4)mGy and 2.39mGy, respectively. For surgical procedures performed in the operating room (n=549) the mean and median CAK values were 36.8(±79.6)mGy and 11.4mGy, respectively. Mean and median CAK values were 65.2(±90.2)mGy and 32.7mGy for gastroenterology procedures (n=98), 16.1(±14.6)mGy and 12.4mGy for urology procedures (n=24), and 46.3(±84.0)mGy and 28.8mGy for pain-management procedures (n=146) performed in neurosurgery department. For procedures performed in the R/F suite (n=203), the mean and median CAK values were 168.2(±262.1)mGy and 72.6mGy. Depending upon the type of procedure, the mean fluoroscopy time ranged from 71 to 497 secs.

SSA20-09 Experimental Validation of Calculated Skin Dose Variation with Incident X-Ray Beam Angle

Sunday, Dec. 1 12:05PM - 12:15PM Room: E351

Participants
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PURPOSE

The incident angle of the x-ray beam on the patient's skin varies during fluoroscopically-guided procedures and accurate estimation of skin dose is important to evaluate the risk of deterministic skin effects. Radiochromic film measurements of skin dose were made as a function of the angle of x-ray beam incidence on a phantom to validate the results of Monte-Carlo calculations.

METHOD AND MATERIALS

To estimate the dose to the skin, a sheet of Gaf-chromic XR-QA2 film was placed on the surface of a 30 cm x 30 cm block of solid water 20 cm thick. To simulate the attenuation of the overlying epidermis, a 1.25 mm thick sheet of PMMA, which is equivalent to 1.5 mm water, was placed over the film. The primary and the scatter dose was measured for incident angles from 90 to 10 degrees at 80 kVp for a field size of 10 cm x 10 cm and the primary entrance air kerma was measured without the phantom. EGSnrc Monte-Carlo (MC) software was used to calculate the skin dose as a function of incident x-ray beam angle for different beam energies and different field sizes. The incident primary dose was calculated in air at the field center and the primary and scatter dose was calculated averaged over various thicknesses of 'skin' to determine the effect on primary attenuation and scatter. All MC simulations used 5x1010 photons incident on the phantom.

RESULTS

The measured skin dose agreed with that calculated by MC with an average difference of about 3 percent over the angular range from 90 to 10 degrees. Both calculated and measured skin dose values decreased with decreasing angle of incidence due primarily to the increased path length and thus increased attenuation of the primary x-rays. In both cases, the total scatter plus primary decreased to about 40% of the primary at an angle of 10 degrees at 80 kVp.

CONCLUSION

Good agreement was obtained between the measured and calculated variation of skin dose with angle of incidence. The skin dose decreases substantially with decreasing incident angle and thus correction factors for angle of incidence should be applied when estimating skin dose for fluoroscopically-guided procedures.

CLINICAL RELEVANCE/APPLICATION

Radiochromic film measurements verified the skin dose dependence on incident angle as calculated with Monte Carlo software so skin dose from fluoroscopic procedures can be more accurately estimated.

SSA21

Physics (CT New Techniques/Systems)

Sunday, Dec. 1 10:45AM - 12:15PM Room: E353B

CT PH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
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Ke Li, PhD, Madison, WI (*Moderator*) Nothing to Disclose

Sub-Events

SSA21-01 A Dynamic Numerical Brain Simulation Model for CT Perfusion Optimization

Sunday, Dec. 1 10:45AM - 10:55AM Room: E353B

Participants
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Norbert J. Pelc, DSc, Stanford, CA (*Abstract Co-Author*) Research support, General Electric Company Consultant, General Electric Company Consultant, NanoX Scientific Advisory Board, RefleXion Medical Inc Scientific Advisory Board, Prismatic Sensors AB Medical Advisory Board, OurCrowd, LP Scientific Advisory Board, Izotropic, Inc Stockholder, Izotropic, Inc

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PURPOSE

Recent research to extend the time window of thrombectomy for ischemic stroke has led to a growing need to understand and optimize the accuracy of CT perfusion (CTP) imaging. This work expands the XCAT brain phantom to model regional physiology and contrast agent kinetics for use in simulating and optimizing CTP studies.

METHOD AND MATERIALS

To enable spatially varying enhancement, the existing 3D NURBS vessels and brain regions were subdivided into smaller volumes. Brain tissue was divided using a physics and constraint solver to generate a 1:1 mapping between the terminal arteries (those without any subsequent branches in the vessel tree) and brain regions fed by each branch. Utilizing the region volume and prescribed tissue perfusion parameters, the flow required by each region is calculated. This determines the flow supplied by the feeding arterial branch and upstream arteries in the vessel tree. Once the flow is determined, the regional contrast agent concentration curves are calculated by propagating the input enhancement curve through the arteries, into the tissue, and drained to the veins. Projections of each dynamic object are simulated for a given acquisition geometry and protocol with CatSim, a CT system simulator. Using the calculated concentration curves, each projection is scaled to have the desired enhancement. The individual scaled projections are then combined to generate and reconstruct the image at each timepoint.

RESULTS

The updated brain phantom contains 78 gray matter regions, 117 white matter regions, 240 vein segments, and 400 artery segments. The framework enables structure specific contrast enhancement as a function of time with flow rates determined from first principles. By identifying individual tissue regions as healthy, ischemic, or infarcted, the model automatically updates the flow in the vasculature to simulate stroke physiology. The flow model combined with a CT simulator generates CTP images compatible with commercially available post-processing software.

CONCLUSION

We have incorporated methods to model the flow physiology of stroke cases to CTP simulations. This work will enable the quantitative assessment of CTP imaging protocols and post-processing techniques.

CLINICAL RELEVANCE/APPLICATION

The validation and optimization of CT perfusion will improve diagnostic tools for stroke patients and increase physicians' ability to prescribe a plan of care driven by quantitative data.

SSA21-02 Evaluation of a Novel Artificial Intelligence Reconstruction Technology in Abdominal CT

Sunday, Dec. 1 10:55AM - 11:05AM Room: E353B

Participants
Mercy Afadzi, PhD, Olso, Norway (*Presenter*) Nothing to Disclose
Kristin Jensen, Oslo, Norway (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To test a new deep learning image reconstruction technique for abdominal CT.

METHOD AND MATERIALS

An anthropomorphic abdomen phantom designed for qualitative and quantitative image quality assessment was scanned on a GE Revolution CT at 120 kVp, dose levels 5, 10 and 15 mGy CTDIvol and 40 mm collimation. All scans were reconstructed with 2.5 mm slice thickness, standard kernel, FBP (ASIR-V 0) , iterative reconstruction (IR) ASIR-V 50, 70 and 90% and deep learning based reconstruction (DLIR) (TrueFidelityTM, GE Healthcare) low (L), medium (M) and high (H). Image quality was evaluated for all reconstruction techniques using noise power spectrum (NPS), Noise texture deviations (NTD), modulation transfer function (MTF), contrast to noise ratio (CNR) and image noise.

RESULTS

Preliminary results show that image noise was reduced for both IR and DLIR reconstruction compared to FBP for all dose levels and noise reduction was independent of dose. Also, image noise was on the same level for DLIR L and ASIR-V 50%, DLIR M and ASIR-V70% and DLIR H and ASIR-V 90%. However, the NPS peak frequency for all levels of DLIR reconstruction were higher than for the IR indicating less blotchiness and a finer image texture. Moreover, the NTD results indicated less artefacts using DLIR reconstruction (@5mGy: DLIR L/M/H ranges from 0.21-0.24 vs ASIR-V 50/70/ 90% 0.28-0.47, @10 mGy DLIR L/M/H ranges from 0.11-0.18 vs ASIR-V 50-90% 0.20-0.45, @15 mGy DLIR L/M/H ranges from 0.22-0.34 vs ASIR-V 50/70/ 90% 0.40-0.57). MTF @50% was at the same level independently of reconstruction techniques for all dose levels (3.5-3.8 @5mGy, 3.5-3.7 @10mGy, 3.79-3.89 @15mGy). CNR was improved using IR and DLIR reconstruction compared to FBP.

CONCLUSION

Both IR and the DLIR reconstruction techniques reduced image noise and improved image quality compared to FBP for all dose levels. In general, the DLIR reconstruction technique was superior to both FBP and IR reconstructions at all dose levels.

CLINICAL RELEVANCE/APPLICATION

New artificial intelligence reconstruction in CT improves image quality in abdominal CT; image texture, image noise, contrast noise ratio and artefact reduction.

SSA21-03 Low Noise, Thin-Slice Chest CT Imaging Using Prior Knowledge Aware Iterative Denoising

Sunday, Dec. 1 11:05AM - 11:15AM Room: E353B

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PURPOSE

The intrinsic trade-off between image noise and radiation dose hampers the adoption of thinner slice thicknesses for diagnostic tasks that could benefit from decreased volume averaging, such as chest CT. This work aimed to quantify the ability of prior-knowledge-aware iterative denoising (PKAID) to enable low-noise, thin-slice chest CT without increase radiation dose.

METHOD AND MATERIALS

PKAID exploits spatially redundant information along z-axis direction, using a prior image with a larger thickness to denoise a thinner-slice image. Phantom and patient studies were conducted to assess the performance of this technique. An anthropomorphic chest phantom was scanned on a 192-slice clinical CT system (Siemens Force). Images were reconstructed using a clinical kernel (Bv49) and 1024 matrix at two slice thicknesses (0.75/1.5 mm). The standard clinical image thickness (1.5 mm) was used as a prior by PKAID to process the 0.75 mm image. The modulation transfer function (MTF), slice sensitivity profile (SSP) and noise power spectra (NPS) were determined before and after PKAID. PKAID was applied to 3 patient cases and the image quality of critical anatomy and pathology was qualitatively assessed.

RESULTS

MTF and SSP showed that PKAID preserved in-plane and z-axis spatial resolution, maintaining the sharpness of 0.75 mm image. The shape of the NPS was preserved even though the amplitude was decreased, demonstrating that PKAID decreases image noise without altering noise texture. In patient cases, 0.75 mm PKAID images allowed better delineation of various pathologies compared to the clinical standard of 1.5 mm images, yet maintained the lower image noise level of the 1.5 mm images.

CONCLUSION

In this work, we demonstrate the ability to decrease image thickness in chest CT, without increasing image noise, by use of a technique that exploits spatial data redundancy in the z-axis direction to reduce image noise. Phantom and in vivo results showed that this technique preserved the spatial resolution and noise texture of 0.75-mm thick chest CT images while reducing the image noise to that of the clinical standard of 1.5 mm images, thereby improving the clarity of very fine anatomic detail in the lungs.

CLINICAL RELEVANCE/APPLICATION

PKAID may better delineate various anatomies and pathologies in chest CT by enabling low noise, thin-slice imaging. It may also be used to maintain a given spatial resolution at lower radiation dose.

SSA21-04 Radiation Dose and Contrast Dose Reduction in Combined Coronary CT Angiography and Iliac Artery

CT Angiography with Personalized Scan Protocol for Preoperative Assessment of Renal Transplant Patients

Sunday, Dec. 1 11:15AM - 11:25AM Room: E353B

Participants
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PURPOSE

To compare the image quality, radiation dose and contrast medium (CM) dose in combined coronary CT angiography (CTA) and iliac CTA for renal transplant patients with personalized and standard scan protocols.

METHOD AND MATERIALS

A total of 77 patients needing assessment for coronary and iliac arteries before renal transplantation were prospectively enrolled. All patients underwent one-stop combined scans on a 256-row CT scanner with automatic tube current modulation, 50% pre-ASIR-V to control radiation dose. CCTA was performed first using one heartbeat axial scan mode with bolus tracking technique and iliac CTA was performed 3-5 seconds after CCTA using a spiral scan. Group A (n=40) used the standard protocol: 100kVp, 60 ml of 350 mgI/ml CM at the flow rate of 4.5 ml/s. Group B (n=37) used a personalized protocol: kVp: 80 (BMI<24) and 100 (BMI>=24) and CM: 19mgI/kg (BMI<18); 21mgI/kg (18<=BMI<24); and 22mgI/kg (BMI>=24). After scanning, all images were reconstructed with 50%ASIR-V.

RESULTS

There was no significant difference in patient demographic data. The contrast dose and radiation dose in the personalized protocol were significantly lower than that in the standard protocol (3.9ml/s vs. 4.5ml/s in flow rate, P<0.01; 31.16ml vs. 60ml in total volume, P<0.001 and 3.85±1.38mSv vs. 4.78±1.17mSv in effective radiation dose, p<0.05). The personalized group had better objective CCTA image quality than the standard protocol group (CNR: 27.37±15.47 vs. 15.47±3.86, P<0.01; SNR: 38.74±16.80 vs. 30.08±20.92, P=0.05). Mann-Whitney test showed that there was no significant difference in the subjective scores of arteries between the two scans (all P>0.05), except the left crown trunk where the standard scan protocol had a higher score (p=0.02).

CONCLUSION

Personalized scan protocol in tube selection and contrast medium selection can significantly reduce the radiation dose and contrast medium dose while maintaining diagnostic image quality for renal transplant patients.

CLINICAL RELEVANCE/APPLICATION

Preoperative assessment of coronary and iliac artery CTA in kidney transplant patients can be completed at a single dose with very low radiation dose and contrast agent dose.

SSA21-05 X-ray CT Image Reconstruction Using Feature Aware Deep Learning Method

Sunday, Dec. 1 11:25AM - 11:35AM Room: E353B

Participants
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PURPOSE

In conventional CT, it is difficult to generate consistent organ specific noise and resolution with a single reconstruction. Therefore, it is necessary in principle to reconstruct a single scan multiple times using different reconstruction parameters such as reconstruction kernel and regularization parameters of model based iterative reconstruction (MBIR) in order to obtain clinical diagnosis information for different anatomies. We provide a deep learning solution which can obtain organ specific noise and resolution balance with a single reconstruction. We propose image reconstruction using a deep convolution neural network (DCNN) trained by a specific feature aware reconstruction target.

METHOD AND MATERIALS

The entire framework of our proposed feature aware deep learning reconstruction method can be found in Fig. 1(a). DCNN takes the conventional filtered backprojection (FBP) image as input and outputs an image with desirable properties. The choice of training target is critical to DCNN. We propose to use a feature aware training target in Fig. 1(b). First, we need to obtain organ specific feature reconstruction. This can be done by reconstructing the image using different regularization parameters of MBIR. The number of feature images can vary depending on the number of anatomies required for clinical purposes. We combine these into a single image as the feature aware training target. We adopted the U-Net as our DCNN. Our training data consists of five dose patient scans. In order to handle different dose levels, for each full dose scans we simulated four low dose scans corresponding to 75%, 50%, 25% and 12% full dose. Then we extract a total number of two hundreds thousand training pairs. We ran 150 epochs in total to ensure effective convergence.

RESULTS

We evaluate our proposed method using two typical real low dose cases. We compare the proposed method to FBP and MBIR with a single adjustable regularization parameter. Fig. 2 shows the comparison for a low-dose pelvis scan. Fig. 3 shows another example of

a low dose chest scan.

CONCLUSION

The proposed method can generate consistent noise and resolution tradeoff which is suited for the specific organs compared to FBP and MBIR.

CLINICAL RELEVANCE/APPLICATION

The proposed method delivers noise consistent image reconstruction with a single reconstruction. Thus, it potentially improving CT work flow while still satisfying clinical diagnostic requirements.

SSA21-06 Assessment of Spatial Resolution as a Function of Focal Spot Size in an Ultra-High Resolution CT System with 6 Selectable Focal Spots

Sunday, Dec. 1 11:35AM - 11:45AM Room: E353B

Participants
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PURPOSE

Most conventional CT systems use two focal spots, but for a ultra-high resolution (0.150 mm pixel dimensions) CT system the focal spot plays a more important role in spatial resolution. The purpose of this study was to evaluate the spatial resolution using the MTF over a range of focal spot sizes and for both super high resolution "SHR" (0.25 mm nominal slice width) and normal resolution "NR" (0.50 mm nominal slice width) modes.

METHOD AND MATERIALS

A ultra-high resolution CT scanner (Aquilion Precision, Canon Medical) was recently installed and evaluated as part of the commissioning process. A modular phantom was developed previously and used for this study, and specifically a series of thin air slits in PMMA were used to produce line spread functions (LSF). The phantom was placed near the isocenter of the system and imaged using all available focal spot settings in both NR and SHR modes. Sufficient mAs values were used at 120 kV to produce LSF images with low noise, and mA and rotation time settings were selected as a function of focal spot mode. A bone kernel was used for filtered backprojection reconstruction. Images were downloaded to a workstation for analysis using Matlab. The air slits were arranged at a slight angle relative to the image matrix to allow for oversampling the LSF to produce the pre-sampled MTF.

RESULTS

The MTF's showed monotonic improvement as the focal spot size got smaller, especially for the SHR mode (1024 matrix with zoom reconstruction) where 4 focal spot sizes were used. The MTFs for the NR mode (512 matrix) showed lower impact from the focal spot sizes, where 6 spots were used.

CONCLUSION

With the advent of high-resolution CT systems for whole body applications, the role of the focal spot dimensions is shown to be much more important than for previous normal resolution scanners.

CLINICAL RELEVANCE/APPLICATION

Because the focal spot size is a selectable parameter on this high resolution CT scanner, system operators need to fully understand the resolution capabilities and constraints of the various focal spot selections to achieve the full high resolution performance of the scanner.

SSA21-07 Detection of Myocardial Infarction Using a Spectral Imaging Method Derived from a Single KV Scan with Deep Learning

Sunday, Dec. 1 11:45AM - 11:55AM Room: E353B

Participants
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PURPOSE

Currently, to detect myocardial perfusion defects, nuclear medicine imaging methods are used in clinical practice. CT based imaging

methods such as CT myocardial perfusion and dual-energy CT are limited by confounding factors such as motion artifacts, radiation dose, and cumbersome clinical workflows. In this work, a deep learning based method was developed to generate iodine maps from a single kV scan and thus enable myocardial infarction detection from a single contrast-enhanced cardiac CT scan.

METHOD AND MATERIALS

A novel deep neural network architecture, referred to as deep spectral imaging network (DSI-Net), was designed and trained to generate two material basis maps from the projection data acquired from a single kV CT scan. To validate the quantitative accuracy of iodine concentration, an anthropomorphic phantom (Lungman) and iodine inserts were scanned using a clinical 64-slice MDCT scanner (Discovery CT750HD, GE Healthcare). The combination of 80kV and 140kV was used to perform the routine dual-energy decomposition to generate a reference iodine map. Iodine maps were then generated from the single 80kV data set and the trained DSI-Net. To demonstrate clinical feasibility, a swine model (N=8) with myocardial defects was scanned using myocardial perfusion CT imaging and PET imaging. The derived myocardial defect zones from these two modalities were compared against the myocardial defect detected by the developed DSI-Net.

RESULTS

Physical phantom studies show that the overall relative mean square error of iodine concentration quantification is 3.2% for the DSI-Net. Quantification of each iodine insert is summarized in the figure caption. As shown in the figure, the defect region derived from DSI-Net is highly correlated with that derived from the myocardial blood volume (MBV) and the defects diagnosed from PET images. The Dice coefficient of the affected territory between the MBV from MPI-CT and the iodine map from DSI-Net is 0.84.

CONCLUSION

It is feasible to use the deep learning based spectral CT imaging method from a single kV acquisition to generate quantitative iodine maps for myocardial perfusion defect detection.

CLINICAL RELEVANCE/APPLICATION

From a single kV CT acquisition, the developed deep spectral CT imaging can enable all of the currently available CT scans be used to generate spectral CT imaging information for quantitative diagnosis without modifications to the current scanner hardware or clinical workflow.

SSA21-08 Phase-Locked Physiological Data for 4D CT: The Application of Standard Video Collection and Motion Enhancement

Sunday, Dec. 1 11:55AM - 12:05PM Room: E353B

Participants
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CONCLUSION

Extracting cardiorespiratory signals from standard video recording is a promising technique for synchronizing and visualizing the physiological state of a patient during dynamic medical imaging.

Background

To facilitate precise interpretation of dynamic medical imaging, synchronized physiological parameters, such as cardiorespiratory phase, need be integrated into the collected dynamic images. While some aspects of this information may be visible during acquisition (e.g. respiratory gating in MRI, and EKG in MRI/CT), it is often difficult to obtain this raw data for post-processing. At our center, interpreting 4D airway scans critically requires the respiratory trace to be overlaid for each scan. Since the Force CT scanner has no ability to collect respiratory data or export cardiac signals, we developed a solution using simple video collection and Eulerian video magnification. Using enhanced motion and color data from video, we demonstrate the ability to generate automated physiological traces that can be integrated with CT images for clinical interpretation.

Evaluation

Eulerian video magnification functions to extract cardiorespiratory phase information by enhancing color and motion. This phase information is easily synchronized with the dynamic CT time-course to facilitate physiologically relevant interpretation. To validate derived data, anesthesia-monitor EKG and respiratory traces were compared to extracted video-signals. This approach has been demonstrated in infants and other patient groups with airway complications. In addition, the best-practice conditions for video capture and the limits of processing parameter choices will be presented.

Discussion

Standard video recordings are easy and inexpensive to obtain. Given the relative inability to collect or extract these signals on a broad range of imaging equipment, the exploitation of Eulerian video magnification and developed approach for re-integration of this data with the DICOM data-set, provides a roadmap for widespread use. Since audio data can be similarly processed, scenarios where this may be useful for artifact confirmation (e.g. crying) or diagnostic enhancement (e.g. linked laryngeal activity) will also be discussed.

SSA21-09 High Temporal Resolution C-Arm Cone-Beam CT Perfusion Imaging

Sunday, Dec. 1 12:05PM - 12:15PM Room: E353B

Participants
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PURPOSE

C-arm cone-beam CT perfusion (CBCTP) imaging is key to enable one-stop-shop stroke imaging in angio-suite for ischemic stroke patients. Due to slow gantry motion, inadequate temporal resolution and temporal sampling in CBCTP acquisitions may limit the accuracy of the generated perfusion maps and thus limit accurate diagnosis of perfusion deficit in interventional suite. In this work, a new reconstruction technique was developed to achieve 30x improvement of temporal resolution for CBCTP perfusion imaging.

METHOD AND MATERIALS

With the SMART-RECON method, multiple CT volumes can be reconstructed from a single acquisition to achieve 4-5 temporal resolution improvement, however, in CBCTP acquisitions, multiple scans are performed by rotating the C-arm gantry in a back-and-forth manner. In this scheme, limited view artifacts demonstrate a strong intrinsic periodicity. In this work, this a priori knowledge of periodicity was incorporated into SMART-RECON, resulting in a significantly enhanced performance for SMART-RECON (eSMART-RECON). A digital anthropomorphic phantom was used to quantify the achievable temporal resolution of eSMART-RECON. The proposed method was also applied to human subject data to demonstrate clinical feasibility. Under IRB approval and written consent, each patient underwent both multi-detector CT perfusion (MDCTP) and CBCTP imaging. The MDCTP and CBCTP images were co-registered and processed with the same software to compute parametric perfusion maps.

RESULTS

The achievable temporal resolution of eSMART-RECON was quantified in the digital phantom as 7.5 fps. Given the gantry rotation speed of 4.2s (corresponding to approximately 0.25 fps), eSMART-RECON yields 30x temporal resolution improvement. The human subject studies demonstrate that eSMART-RECON can accurately capture the temporal variation of cerebral tissues as perfusion maps derived from eSMART-RECON CBCTP closely resemble MDCTP maps (see figure).

CONCLUSION

A new technique, eSMART-RECON, was developed and validated to achieve significantly improved temporal resolution to enable accurate CBCT perfusion imaging.

CLINICAL RELEVANCE/APPLICATION

With the ability to produce accurate perfusion maps in interventional suite, the workflow of endovascular treatment for acute ischemic stroke patients can be further optimized to reduce the time from stroke onset to treatment such that more brains can be saved since time is brain in ischemic stroke patient management.

Printed on: 10/29/20

SSA22

Physics (MRI - New Techniques and Image Quality)

Sunday, Dec. 1 10:45AM - 12:15PM Room: E353A

MR PH SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

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Sub-Events

SSA22-01 Hybrid MR-OR Siting and Safety

Sunday, Dec. 1 10:45AM - 10:55AM Room: E353A

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CONCLUSION

The hybrid MR-OR environment provides many clinical advantages but is not free of a certain degree of risk. The risk is further compounded with lack of consistent safety standards. Engineering MR safety into the practice design and strict adherence to MRI safety checklists, policy enforcement and regular personnel training is critical to maintaining MR safety in this complex multidisciplinary procedural environment.

Background

Hybrid MR-OR for interventional and intraoperative procedures has emerged from its infancy to a standard setup at major academic medical centers. The American College of Radiology (ACR) white paper on MR Safety is a primary reference used by most sites for designing MR safety best practices; unfortunately, it is lacking specific guidance on hybrid MR-OR siting and safety. We attempt to provide a template for hybrid MR-OR siting and safety that builds on the ACR white paper terminology and covers unique considerations regarding design, layout, access, training, screening, infection control and procedural considerations when developing hybrid MR-OR siting and safety practices.

Evaluation

A key challenge of hybrid MR-OR environment is its multidisciplinary, interdepartmental nature, and as such requiring a strong collaborative approach in the design of the hybrid environment and implementation of education and safety protocols. Safety not only has to be forefront in awareness, but also engineered into the workflow. We highlight three key elements of engineering safety into the practice design through 1) siting considerations 2) workflow and training considerations and 3) procedural safety considerations.

Discussion

Siting considerations should include architectural layout, scanner choice (on rails vs stationary), zone designs, and screening equipment. Workflow and training consideration should include staff training (with emphasis on hands-on training), access control, and patient/staff movement. Procedural safety considerations should include level 2 personnel staffing, patient screening, procedural pause, surgical equipment screening, and infection control. Ongoing evaluation of procedural process is critical as new procedures are added.

SSA22-02 Lower Risk of Hearing Loss Without Sacrificing Image Quality in Fetal MR Imaging: A Feasibility Study Using Acoustic Reduction Technique

Sunday, Dec. 1 10:55AM - 11:05AM Room: E353A

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PURPOSE

The purpose of this study was to evaluate whether ART is reliable and applicable in fetus brain imaging.

METHOD AND MATERIALS

We collected from September 2017 to October 2018 using 3.0T MR scannerfor fetal head exams. 10 subjects underwent ART sequences (group A), the matched 10 subjects underwent traditional sequences (group B). The protocol of tradition sequences includes T2 single short fast spin echo (SSFSE) (axial, sagittal, coronal); while the ART sequences contains ART T2 SSFSE (axial, sagittal, coronal) (Table1). A quantitative assessment by the ROI of 1 mm was manually placed on the different layers of the brain (Fig 1A). A qualitative evaluation including eight criteria (1. Delineation of germinal zone and gray matter, 2. Delineation of white matter, 3. Delineation of internal and external CSF spaces, 4. Delineation of amniotic fluid adjacent to the skull, 5.Delineation of brain stem, 6. Delineation of cerebellum, 7. Severity of motion artifacts, 8. Overall image quality) were evaluated on an ordinal scale regarding signal characteristics, potential dysmorphism and developmental anomalies (5= optimal diagnostic quality; 4= very good image quality;3= diagnostic image quality, 2= image quality below diagnostic standards; 1= image quality too poor to correctly identify anatomy.

RESULTS

The maximum differences of peak and equivalent sound pressure between the two groups are 18.1dBA and 16.1dBA respectively, indicating the ART sequences have lower noise than traditional sequences. Comparative ratios calculated between germinal matrix/air, periventricular layer/air, subplate layer/air, and cortical layer/air for group A (33.97±17.52, 42.45±16.65, 46.37±22.46, 43.03±20.89) were lower than that of group B (52.54±25.61, 33.39±12.91, 69.17±35.21, 64.76±32.53), but with no significant difference (P=0.09,0.20, 0.12, 0.11) . The qualitative results showed that the image quality of group B and group A scored 4.42 + 0.37 and 4.36 + 0.49 respectively. There was no significant difference in image quality score between the two groups.

CONCLUSION

Acoustic reduction sequence can acquire high quality images in 3.0T scanner, meanwhile decrease hearing loss risk in fetal head examinations compared with the conventional method.

CLINICAL RELEVANCE/APPLICATION

Acoustic reduction sequence can acquire high quality images in 3.0T scanner, meanwhile decrease hearing loss risk in fetal head examinations compared with the conventional method.

SSA22-03 Multi-Site, Multi-Vendor, and Multi-Platform Assessment of Accuracy of Quantitative Proton-Density Fat Fraction (PDFF) at 1.5 and 3 Tesla with a Standardized Spherical Phantom: Results from a Study by the RSNA QIBA PDFF Committee

Sunday, Dec. 1 11:05AM - 11:15AM Room: E353A

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PURPOSE

Proton Density Fat Fraction (PDFF) is a popular MRI/S biomarker of hepatic steatosis. The QIBA PDFF Committee was formed in 2015. In this work, the committee conducted a multi-center and multi-vendor phantom study. The objective was to characterize the accuracy of PDFF as a robust biomarker, as measured by various SPGR chemical-shift-encoded sequences against a standardized phantom with known PDFF values.

METHOD AND MATERIALS

9 sites with multiple commercial 1.5T and 3T systems were invikved. The phantom contained 12 vials of known PDFF. Sites were asked to test several protocols, to their best capability. P1: a vendor-sourced 'out-of-the-box' liver PDFF protocol. Each site ran P1 'as is', using default parameters for GE's IDEAL-IQ, Siemens' LiverLab, and Philips' mDIXON-Quant. P2: a complex-based QIBA recommended protocol. P3: a magnitude-based Liver Imaging of Phase-interference signal Oscillation and Quantification protocol. Each site acquired P1-P3 data, which were reviewed by an independent reader. For P1 and P2, each vendor's online multi-fat-peak complex-based data reconstruction algorithm and software was used for PDFF generation, with no modifications to reconstruction parameters. No work-in-progress software was used. For P3, data were sent to an additional independent site for multi-fat-peak magnitude-based reconstruction. A single analyst made all PDFF measurements. Linear regression was performed against reference values.

RESULTS

149 scans of the phantom were performed, 45 on 1.5T (15xP1, 12xP2, 18xP3), and 104 on 3T (33xP1, 24xP2, and 47xP3). Pooled P1 data for 1.5T: (slope=0.97, bias=0.15, r2=0.99), for 3T: (slope=0.99, bias=-0.69, r2=0.99); pooled P2 data for 1.5T: (slope=0.99, bias=-0.35, r2=1.0), for 3T: (slope=1.0, bias=-1.01, r2=0.99); pooled P3 data for 1.5T: (slope=0.96, bias=-0.25, r2=1.0), for 3T: (slope=0.97, bias=-0.02, r2=0.99). Lin's concordance correlation coefficient for all 1.5T data was 0.9973 and 0.9972 for all 3T data.

CONCLUSION

Quantitative PDFF data collected in a standardized phantom are accurate using vendor-source and QIBA-recommended complex-based water-fat separation protocols and an independent magnitude-based protocol.

CLINICAL RELEVANCE/APPLICATION

The PDFF from MRI and MRS is a robust and accurate quantitative imaging biomarker of hepatic steatosis across different magnet field strengths, imager manufacturers, and reconstruction methods.

SSA22-04 Effect of Post Labelling Delay on Arterial Spin Labelling

Sunday, Dec. 1 11:15AM - 11:25AM Room: E353A

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CONCLUSION

Single PLD ASL is a robust technique in obtaining CBF values but the accuracy is still confounded by the PLD settings. This study showed that CBF values at different PLD could be significantly different. 2000ms was the most appropriate settings (27/29 cases) which agreed well with the white paper. We also noticed that ATA signs could present after 2000ms. Radiographers should take up the role in real time image interpretation. If ATA were spotted, repeated examination with a longer PLD would be necessary.

Background

Arterial Spin Labelling (ASL) is a MRI perfusion technique utilizing magnetically labelled blood as endogenous tracers. Post Labelling Delay (PLD) is applied to ensure an equilibrium state is reached. However, a short PLD could not ensure an equilibrium state while a long PLD could lead to reduced SNR. Failure to account for could compromise the accuracy.

Evaluation

29 dementia patients in December 2018 were prospectively recruited. Pseudo-continuous ASL was acquired in a 3T scanner (Achieva, Philips Healthcare) with 3 PLD settings (TR=4000ms, TE=11ms, labeling-duration=1600ms, PLD=1800/2000/2500ms). Data analysis were done by MRIcloud online.

Discussion

Recommended single compartment model should give the same CBF values regardless of the PLD settings but our data showed that CBF values at each PLD were significantly different (Repeated measures ANOVA, p=0.000). After referencing with the buxton's kinetic model, 5 conditions were recognized and summarized in the figure. 2 cases showed 'steady state' in which CBF values were similar at each PLD. 10 cases showed 'ATA effects' in which equilibrium was reached after 2000ms. CBF values at 1800ms was erroneous as it violated the model assumption. 9 cases showed 'SNR penalty' in which there might be measurement errors due to reduced SNR at 2500ms leading to abnormally low CBF values. CBF values could not converge in the remaining 8 cases.'Mixed effects' (n=6) might be due to a combination of 'ATA effects' and 'SNR penalty' where 2000ms, theoretically, would be the acceptable setting. In 'severe ATA effects' (n=2), CBF values at 2000ms were abnormally high due to an incorrect model inversion. 2500ms would be the appropriate choice.

SSA22-05 Using Water-In-Oil Emulsions in Phantom for Quality Control of Diffusion-Weighted Magnetic Resonance Imaging

Sunday, Dec. 1 11:25AM - 11:35AM Room: E353A

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CONCLUSION

We developed a phantom containing control substances with predefined apparent diffusion coefficients ranging from normal tissue to benign and malignant lesions. The use of W/O emulsions as a part of the phantom allowed modeling a restricted diffusion represented in the image by a high-intensity signal in a wide range of the b-value. The proposed substances also allow evaluating the effectiveness of fat suppression.

Background

To control the quality of diffusion-weighted magnetic resonance imaging (DWI), phantoms with control substances (with stable physical characteristics and known diffusion coefficients) are used. According to literature, aqueous solutions of polymer are used to achieve different diffusion coefficients. These materials model only hindered diffusion, while the diffusion of water molecule inside the cell is restricted. In this work we give results of combination water-in-oil (W/O) emulsions and polymer solutions to model not only restricted, but also hindered diffusion.

Evaluation

As a hindered diffusion model, we used aqueous solutions of polyvinylpyrrolidone (PVP) with concentrations of 0-50%. We created W/O emulsions to simulate a restricted diffusion based on substances with high time T2 - siloxanes: cyclomethicone (Cycl) and caprylyl methicone (Cap). We chose emulsions with equal proportions of water/fatty phases: 1:1 Cap:Water and 1:1 Cycl:Water. According to the dispersion analysis, the size of micelles in the emulsions was 4.8±1.8 μm. The apparent diffusion coefficient (ADC) of emulsion depends on the true diffusion coefficient inside micelles and the time interval between diffusion gradients Δ. We also included silicon oil in phantom to control fat suppression. To estimate the effectiveness of phantom, we scanned it on different MR scanners.

Discussion

With the increase of Δ from 44.4 ms to 60 ms, we restated the decrease of ADC of emulsion by 0.02 μm2/ms, whereas this effect wasn't observed for water and Cap. True diffusion coefficients of material were determined with the accuracy of 4%. When comparing the ADC results of different MR scanners, the mean variation reached 5.1%, and the relative error was 9.3%. The use of correction factor allow decreasing the error to 2.5 %.

SSA22-06 Improvement of Late Gadolinium Enhancement Image Quality Using a Novel, Deep Learning Based, Reconstruction Algorithm and Its Influence on Myocardial Scar Quantification

Sunday, Dec. 1 11:35AM - 11:45AM Room: E353A

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PURPOSE

The aim of this study was 1) to evaluate myocardial late gadolinium enhancement (LGE) image quality using a deep learning (DL) based magnetic resonance image reconstruction algorithm and 2) to assess its effect on the quantification of myocardial scar.

METHOD AND MATERIALS

Thirty-five patients (46±17y, 51% male) with suspected ischemic or non-ischemic cardiomyopathy underwent cardiovascular magnetic resonance imaging (CMR) with gadolinium contrast (0.15 to 0.2 mmol/kg; Gadovist) on a 1.5T scanner (SIGNA Artist, GE Healthcare). Short axis 2D LGE images were reconstructed twice: once with the vendor standard reconstruction, and once with vendor supplied DLRecon prototype. The DL reconstruction is based on a deep convolutional residual encoder network trained from a database of over 10.000 images to reconstruct images with high signal-to-noise ratio (SNR) and high spatial resolution. The

network offered tunable noise reduction (NR) factors from 0-100% to accommodate user preference. Two observers scored image quality and myocardial nulling of both original images and reconstructed images with 75% NR level using a 5 point scale (1=poor to 5=excellent). SNR and contrast-to-noise ratio (CNR) were measured. In 20 patients with LGE, scar size was quantified using thresholding by 2, 4, and 6 standard deviation (SD) above remote myocardium, and using full width at half maximum (FWHM) technique in images with 25%, 50%, 75% and 100% NR levels.

RESULTS

Both image quality and myocardial nulling improved by DLRecon method (3.3±0.6 vs. 3.7±0.6, p<0.001 and 3.3±0.6 vs. 3.4±0.6, p=0.03). SNRscar and CNRscar-remote increased significantly with 150% and 158%, respectively at a NR level of 75% (both p<0.001). Due to reduction in noise, scar size increased significantly with increasing NR levels using SD methods, however with the FWHM method no difference in scar size was found (figure).

CONCLUSION

Using a novel, deep learning based, reconstruction algorithm myocardial LGE image quality improved significantly. However, these algorithms have important impact on scar size quantification depending on technique used. The FWHM method is preferred because it is independent of the level of noise.

CLINICAL RELEVANCE/APPLICATION

LGE by CMR is the gold-standard technique for assessing myocardial scar and by using a novel, deep learning based, image reconstruction algorithm image quality can be improved.

SSA22-07 Comparison Between Readout Segmented Diffusion Weighted Imaging and Single Shot Echo Planar Imaging in Image Quality

Sunday, Dec. 1 11:45AM - 11:55AM Room: E353A

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PURPOSE

To compare difference of readout segmented diffusion weighted imaging (RS-EPI) and single shot echo planar imaging (SS-EPI) on image quality with ultra-high b value for prostate cancer detection.

METHOD AND MATERIALS

37 patients with prostate disease who underwent both RS-EPI and SS-EPI were enrolled in this study. All data were collected on a 3T MR scanner (MAGNETOM Skyra, Siemens Healthcare, Erlangen, Germany) with the b value of 0, 1000 ,2000 , 3000s/mm2. The image quality including lesions clarity, anatomical distortion, image sharpness, detail display based on diffusion weighted imaging (DWI) were classified according to Likert score into 1 to 5 grade.(Grade 1 : cannot be used for diagnosis; Grade 2: poor; Grade 3: acceptable; Grade 4: good; Grade 5: very good.) All the images were analyzed by two experienced radiologists blinded to any clinical information as well as MR sequence type. The classification was provided from two radiologists separately. The signal-to-noise ratio (SNR), and contrast ratio, and contrast to noise ratio (CNR) were also measured on workstations by the radiologist.

RESULTS

The scores concluded by the two radiologists have good consistency, Kappa value>0.80. The image quality including lesions clarity, anatomical distortion, image sharpness, detail display obtained from RS-EPI sequences were higher than those obtained from SS-EPI regardless of 1000, 2000, 3000s/mm2 (P<0.001). The signal-to-noise ratio (SNR), and contrast ratio, and contrast to noise ratio (CNR) measured on RS-EPI sequences were also higher than those measured on SS-EPI (P<0.001) (table1).

CONCLUSION

Compared with the SS-EPI sequence, ultra-high b value RS-EPI sequence significantly improves the image quality, which is more conducive to the detection of prostate lesions.

CLINICAL RELEVANCE/APPLICATION

Compared with the SS-EPI sequence, ultra-high b value RS-EPI sequence significantly improves the image quality, which is more conducive to the detection of prostate lesions.

SSA22-08 Radiologic Technologists' Decision-Making for Protocol Repetition in Whole-Body MR Imaging and the Potential for Automated Image Quality Assessment: A Large Population-Based Cohort Study

Sunday, Dec. 1 11:55AM - 12:05PM Room: E353A

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PURPOSE

Cost-effectiveness in health care delivery and diagnostic medical imaging have become increasingly important. Such considerations are relevant when repeating protocols in Whole-Body MR imaging, especially when conducting large cohort studies. We studied the frequency of protocol repetition by radiologic technologists who performed whole-body MR imaging protocols in the multi-center German National Cohort (GNC), and the impact of automation on the need for protocol repetition, considering the local, staffing, and technical factors involved. Additionally, we studied its impact on scan time, automated image quality assessment, and protocol repetition.

METHOD AND MATERIALS

A total of 11,347 subjects underwent whole-body MRI as part of the MR sub-study of the GNC cohort (2014-2016). Whole-body imaging was conducted at five sites using a uniform set of twelve protocols. Image acquisitions were independently conducted by radiologic technologists (RT), whose decisions for protocol repetition was compared with image quality parameters that were automatically derived.

RESULTS

At least one repeat protocol by the RT occurred in 12% (n=1,365) of subjects. The frequency of repetition differed across protocols ($p<0.0001$), and across sites (range: 5.28%-24.34%, $p<0.0001$), and varied over time ($p<0.0001$). Mean total scan time of 62.6min increased by 4.8min (95%CI: 4.5-5.2min) in subjects needing protocol repetition. The automatically-derived image quality parameters that retrospectively predicted the need for protocol repetition included image sharpness and signal-to-noise ratio. However, their predictive value was not uniform across all protocols.

CONCLUSION

The need to repeat MR protocols, even in highly standardized settings such as population study cohorts, is highly prevalent. Our findings indicate that automated image quality assessment has predictive value, and reduces the need for protocol repetition, thereby improving workflow efficiency and cost-effectiveness in the conduct of such studies.

CLINICAL RELEVANCE/APPLICATION

Patients find MRI studies daunting, hence MRI protocol repetition by radiologic technologists increase not only costs, but also patient discomfort. Automation of MRI image workflow has the potential to improve both.

SSA22-09 An Experimental Study of MRI Induced Heating in Conductive Loops

Sunday, Dec. 1 12:05PM - 12:15PM Room: E353A

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CONCLUSION

This work indicates that size and presence of a gap are factors to consider in the risk assessment of piercings. It has important implication for dermal piercings since there may be unknown gap in the piercing under the skin.

Background

Patients who are unable or reluctant to remove metallic piercings before MRI are at risk of injuries due to magnetic force and radiofrequency (RF) heating. While magnetic force risk can be reduced by screening with a ferromagnetic detector, it is harder to assess the risk of RF burn from piercing. The purpose of this investigation is to conduct experiments to evaluate the relationship of RF heating with the size and configuration of conductive loops to provide a better understanding of the factors related to RF heating in piercings.

Evaluation

The study was conducted on a GE 3T MR system. Circular loops of diameter 5cm, 8cm and 11cm with an air gap of 0, 0.3mm or 2.5mm for each diameter were constructed from copper wire (gauge 10). They were placed one at a time horizontally in a container with the loop touching the skin of a pig knuckle specimen at the loop gap position. The setup was mounted on top of a 27cm spherical phantom and scanned using a fast spin echo sequence for 10:33 minutes. Temperature at the contact point between each loop and the specimen skin was measured with a Philips patient monitor temperature sensor. The results show temperature rise of 1.4 and 1.8 deg C in the 8cm loops with a gap of 0.3mm and 2.5mm respectively, and temperature rise of 5.0 and 5.2 deg C in the 11cm loops with a gap of 0.3mm and 2.5mm respectively. There was no measured temperature increase in all loops with zero gap and in the 5cm loops with a gap.

Discussion

This study shows that RF heating risk increases with the size of conducting loops and with the presence of a gap. The result indicates high induced electric field at the gap of the larger loops causes current to flow in the skin with high resistance leading to the heating. However, this study does not imply MRI safety for piercings smaller than a certain size or without a gap since RF heating depends also on other factors and settings not covered in this study.

SSA23

Radiation Oncology (Radiobiology/Science)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S502AB

RO

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Martin Colman, MD, Salt Lake City, UT (*Moderator*) Stockholder, Steward Health Care
Aaron J. Grossberg, MD, PhD, Portland, OR (*Moderator*) Nothing to Disclose
Hina Saeed, MD, Milwaukee, WI (*Moderator*) Nothing to Disclose

Sub-Events

SSA23-01 Imaging and Treatment of Primary and Metastasized Tumor via Abscopal Immunotherapy Effect, and Reduction of Circulating Tumor Cell Using Targeted Antigen-Capturing Nanoparticles Containing Chitosan and Anti-sema7a Antibodies Directed by Radiation

Sunday, Dec. 1 10:45AM - 10:55AM Room: S502AB

Participants
Satoshi G. Harada, MD, Morioka, Japan (*Presenter*) Nothing to Disclose
Takahiro Satoh, DSc, Takasaki, Japan (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The aim of this study was to image and treat primary and metastasized tumors, by immuno-radiotherapy via dendritic cell (DC)-mediated T-cell priming under PD-L1 blockade and to reducing circulating tumor cells (CTCs) via CHI3L1 inhibition, using nanocapsules that release antigen-capturing nanoparticles (AC-NPs) containing chitosan nanoparticles (ChNPs) and an anti-Sema 7a antibody (Ab) in two radiation sessions.

METHOD AND MATERIALS

For session 1, nanocapsules generated by modifying iopamiron and 400 μg anti-PD-L1 antibody (Ab) were mixed with 1.0 mL of a 4% alginate, 3% hyaluronate, and 1 μg/mL P-selectin solution and sprayed into 0.5 mmol/L FeCl2, supplemented with 1 μg/mL anti-a4ß1 Ab. Nanocapsules were injected intravenously (IV) into BALB/c mice with primary LM17 tumors in the left hind leg and lung metastases. After 9 h, primary tumors were exposed to 10 or 20 Gy 60Co γ-rays. For session 2, ChNPs were prepared by electrospraying and were encapsulated in poly(lactic-co-glycolic) acid (PLGA) AC-NPs using a nanoprecipitation method. The particles and 350 μg/mL anti-Sema 7a Ab were further mixed with the above cocktail and sprayed into 0.5 mmol/L FeCl2, supplemented with 1 μg/mL anti-P-selectin Ab. Nanocapsules (1 × 1010) were injected IV. After 9 h, tumors were irradiated as before.

RESULTS

In session 1, anti-a4ß1 nanocapsules accumulating around primary and metastatic tumors were detected by CT. Nanocapsules released P-selectin and anti-PD-L1 Ab upon irradiation. In session 2, nanocapsules accumulated around primary tumors via a P-selectin Ag-Ab reaction and released PLGA AC-NPs containing ChNPs and Sema-7a Ab. PLGA AC-NPs captured and transported tumor-derived protein antigens released by the second radiation dose to DCs, which intensified DC-mediated CD8+ T-cell priming. The primed CD8+ T-cells attacked primary and metastatic tumors, in which PD-L1 was suppressed in session 1. Further, Sema-7a Ab and ChNPs from PLGA AC-NPs inhibited CHI3L-induced CTCs, which reduced new metastases. These treatments showed antitumor effects (EF 1.7) and reduced metastasis by 86.5%.

CONCLUSION

Our nanocapsule improved both tumor diagnosis and treatment.

CLINICAL RELEVANCE/APPLICATION

Targeted AC-NPs, ChNPs, and Sema-7a Ab under PD-L1 blockade showed antitumor effects on primary and metastatic tumors.

SSA23-02 Significance of Manipulating Tumor Hypoxia and Radiation Dose Rate in Terms of Local Tumor Control and Distant Lung Metastasis

Sunday, Dec. 1 10:55AM - 11:05AM Room: S502AB

Participants
Shinichiro Masunaga, MD, Osaka, Japan (*Presenter*) Nothing to Disclose
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Akira Maruhashi, Osaka, Japan (*Abstract Co-Author*) Nothing to Disclose
Koji Ono, MD, PhD, Osaka, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the influence of manipulating intratumor oxygenation status and radiation dose rate on local tumor response and distant lung metastases following radiotherapy, referring to the response of quiescent (Q) cell populations within irradiated tumors.

METHOD AND MATERIALS

B16-BL6 melanoma tumor-bearing C57BL/6 mice were continuously given 5-bromo-2'-deoxyuridine (BrdU) to label all proliferating (P) cells. They received γ-ray irradiation at high dose-rate (HDR) or reduced dose-rate (RDR) following treatment with the acute hypoxia-releasing agent nicotinamide or local hyperthermia at mild temperatures (MTH). Immediately after the irradiation, cells from some tumors were isolated and incubated with a cytokinesis blocker. The responses of the Q and total (= P + Q) cell populations were assessed based on the frequency of micronuclei using immunofluorescence staining for BrdU. In other tumor-bearing mice, 17 days after irradiation, macroscopic lung metastases were enumerated.

RESULTS

Following HDR irradiation, nicotinamide and MTH enhanced the sensitivity of the total and Q cell population, respectively. The decrease in sensitivity at RDR irradiation compared with HDR irradiation was slightly inhibited by MTH, especially in Q cells. Without γ-ray irradiation, nicotinamide treatment tended to reduce the number of lung metastases. With γ-rays, in combination with nicotinamide or MTH, especially the former, HDR irradiation decreased the number of metastases more remarkably than RDR irradiation.

CONCLUSION

Both manipulating tumor hypoxia and irradiation dose rate showed the potential to influence lung metastasis. In HDR than RDR irradiation, the combination with the acute hypoxia-releasing agent nicotinamide may be promising in terms of reducing the number of lung metastases. Further, control of the acute hypoxia-rich total cell population in the primary tumor in addition to control of the primary tumor as a whole with HDR, rather than RDR irradiation, has an impact on the potential to reduce the numbers of lung metastasis.

CLINICAL RELEVANCE/APPLICATION

Treatment for manipulating tumor hypoxia in a way like MTH and irradiation at higher dose rate may show the potential to not only improve local control rate but also suppress the possibility of distant lung metastasis.

SSA23-03 Radiation Boosts to EPR pO2 Image Based Hypoxia Improves Tumor Control in Two Preclinical Cancer Models

Sunday, Dec. 1 11:05AM - 11:15AM Room: S502AB

Participants
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PURPOSE

Hypoxic resistance to radiation in living cells has been known for over a century, but boosting with extra radiation to localized hypoxic tumor subregions - dose painting - has never been shown beneficial. Using quantitative electron paramagnetic resonance (EPR) pO2 imaging and novel rapidly printed tungsten loaded plastic blocks to direct boosts, we randomized radiation boosts to well oxygenated vs hypoxic tumor in two tumor types to determine if the hypoxic boost enhanced tumor control.

METHOD AND MATERIALS

54 FSa fibrosarcoma and 48 MCa4 mammary carcinomas were grown to ~0.35 ml volume in C3H mouse legs and treated with whole tumor radiation dose sufficient to control 15% of tumors using an XRAD225Cx radiator. Immediately prior T2 MRI to define tumor location and EPR pO2 images were registered with the XRAD. Tungsten loaded plastic blocks were 3D printed randomly designed to provide additional boost dose sufficient to control 95% of tumors to either 99% of hypoxic tumor voxels (pO2<=10 torr) or well

oxygenated tumor regions of equal volume with opposed oblique fields. Mice were then followed for 90 days (FSa) or 180 days (MCa4) for local tumor recurrence. Kaplan-Meier survival analysis determined the significance of differences between boost radiation to hypoxic or well oxygenated tumor portions of ~equal volume for each tumor type.

RESULTS

Two consecutive tumor types were tested with mature tumor control data. Both tumor types showed radiation boosts directed to hypoxic tumor defined by EPR pO2 images increased tumor control by a significant (p=0.04 & p=0.013 respectively) factor of at least two relative to boosts directed to well oxygenated tumor as shown in the figure. Limitations: 1) single fraction radiation treaments. 2) Boost doses chosen equal to that for whole tumor 95% cure. Clearly, other factors than hypoxia produce resistance to radiation.

CONCLUSION

EPR pO2 images identified hypoxic tumor portions and randomly directed boosts (hypoxic vs well oxygenated) in two consecutive mouse tumor types giving highly significant doubling of long term tumor control and thereby the first mammalian justification for radiation dose painting within a tumor volume.

CLINICAL RELEVANCE/APPLICATION

Radiation dose painting enhances therapeutic ratio by protecting critical structures. This work presents the first mammalian justification of dose painting within a tumor to potentially reduce integral radiation dose necessary for tumor cure.

SSA23-04 DNA Double-Strand Break Induction and Repair of Proton Computed Tomography in Normal Human Cells

Sunday, Dec. 1 11:15AM - 11:25AM Room: S502AB

Participants
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PURPOSE

Proton computed tomography (pCT) offers a promising solution for reducing range uncertainties from X-ray CT planning and allowing daily pre-treatment verification. There is already evidence for increased dosimetric accuracy of pCT, but experimental biological data on the RBE of pCT for DNA double-strand break (dsb) induction and repair is scant. The purpose of this work is to provide such data.

METHOD AND MATERIALS

DNA dsb induction and repair were investigated in normal human astrocytes (NHA) and human umbilical vascular endothelial (HUVEC) cells. We hypothesized that the RBE for induction and repair of DNA dsbs is less than 1 with respect to kV x-ray CT. Moreover, genotoxicity will be assessed by the repair studies. DNA dsbs were detected using the γH2AX foci assay using confocal laser scanning imaging of radiation-induced foci. Cells were exposed to 200 MeV protons behind a mock-setup of a pCT scanner in a tissue equivalent cube inserted into the posterior fossa of a rotating head phantom. Proton CT dose calibrations performed in this head phantom set-up corroborated standard clinical dosimetry methods. γH2AX dose-response curves and repair curves were obtained. For repair experiments, cells were exposed to 1 Gy and then permitted to repair the damage at 37oC for varying durations. The pCT data were compared to DNA dsb induction and repair in both cell lines after exposure to radiation from a single energy CT and dual energy CT.

RESULTS

Fewer DNA dsbs per Gy were found in NHA cells compared to HUVEC cells after exposure to pCT but both cell lines had essentially repaired all of the DNA dsbs by 10-15 hours post exposure. Initial results seem to indicate that the RBE of proton CT for dsb induction is, in fact, lower than 1 compared to x-ray CT in agreement with recent computational modeling studies.

CONCLUSION

Altogether the results of this team effort provide a valuable estimation of RBE for DNA dsbs and genotoxic effects from exposure to proton CT.

CLINICAL RELEVANCE/APPLICATION

Proton CT will become available clinically soon. It will significantly improve the accuracy of proton therapy, reduce the dose from daily image guidance, and potentially have a lower RBE. This work has been supported by a research grant from IBA International.

SSA23-05 Radiosensitization of Human Cancer Cells in Vitro with Focused Ultrasound Induced Hyperthermia

Sunday, Dec. 1 11:25AM - 11:35AM Room: S502AB

Participants
Xinrui Zhang, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
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Ina Patties, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose

Lisa Landgraf, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Hyperthermia (HT; 40-46°C) is known to sensitize cancer cells to radiation therapy (RT) but the temperature rise cannot be quantified clinically. MR guided Focused ultrasound (MR-FUS) allows to generate local HT in a quantifiable way. In this study, impact of combined FUS-HT and RT treatment on human cancer cells was investigated in vitro to provide the base of the clinical use.

METHOD AND MATERIALS

Human glioblastoma (T98G) and prostate (PC-3) cancer cells were seeded in ultrasound-penetrable 96-well plates (Greiner Bio One). We have used a special sonicator for cell culture plates developed at IMSaT (University Dundee) and modified by us comprised by a programmable VXM motor controller and a NEMA 17 stepper motor (VELMEX Inc.). FUS-HT (45°C, 30 min) was induced with a customized 1.14 MHz transducer at 214 W/cm2. Temperature was monitored by thermal camera (Optris). HT (45°C, 30 min) in incubator worked as control. Single RT was applied at 10 Gy with an X-Ray device (DARPAC 150-MC; 1.28 Gy/min) within 60 min after RT. Effects on metabolic activity (WST-1, Roche) and DNA double-strand breaks (γH2A.X, Cell signalling) were evaluated.

RESULTS

Combination of FUS-HT and RT leads to decreased metabolic activity (T98G: 52 %; PC-3: 45 %) compared to single RT (T98G: 72 %; PC-3: 76 %) 72h after treatment. In contrast, classic HT+RT reduced metabolic activity to a lower extend (T98G: 57 %; PC-3: 50 %). FUS-HT combined with RT significantly ($p < 0.05$) enhance the number of initial DNA double-strand breaks (T98G: 21; PC-3: 11 foci/nucleus) compared to RT alone (T98G: 14; PC-3: 6 foci/nucleus) 1h post treatment.

CONCLUSION

Our data imply that FUS-HT shows potential to radiosensitize cancer cells. Increased DNA damage suggests an inhibition of repair mechanism and is further investigated. A new in vitro high throughput FUS system will now be completed.

CLINICAL RELEVANCE/APPLICATION

Focused ultrasound is an non-invasive way to generate precise local hyperthermia and sensitize cancer cells for radiation therapy or chemotherapy by synergistic effect.

SSA23-06 Demystifying the Radiation Risk in Pregnancy: How Much is Too Much?

Sunday, Dec. 1 11:35AM - 11:45AM Room: S502AB

Participants
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PURPOSE

To gain knowledge about the established guidelines and protocols while imaging pregnant women and to deal with the radio-phobia associated with it. To assess the knowledge of radiology department staff with regards to radiation safety in pregnancy.

METHOD AND MATERIALS

• The knowledge of the radiology departmental staff (consultants, residents, technicians, clinicians) in regards to doses, effects of radiation and imaging protocol in pregnancy,etc.,were assessed by analyzing their response to a set of questionnaires (1st audit). • Lectures were conducted for the departmental staff regarding the established guidelines and fallacies related to radiation risk in pregnancy. • 2nd audit conducted (3 months after 1st audit) for the assessment of progress • Results & observations: Significant improvement in awareness was observed in second audit results among radiology consultants (60 % vs. 100 %) radiology residents (30 % vs. 100%), technicians (40 % vs. 80%) and clinicians (30% vs. 80 %)

RESULTS

Significant interval improvement in awareness is demonstrated among residents, technicians and clinicians.

CONCLUSION

Imaging studies that can provide significant diagnostic information should not be withheld in case of pregnancy.

CLINICAL RELEVANCE/APPLICATION

Imaging in pregnancy is a challenging situation due to the hazards related to exposure of ionizing radiation to the fetus in-utero. However, in typical diagnostic radiological examinations such a risk is very minimal. At times, diagnostically useful imaging studies are denied to the pregnant women because of unsubstantiated fears mostly based on erroneous data, inspite of clinical benefits greatly outweigh the hypothetical risks. Dose in a typical diagnostic study rarely exceed >25mGy while as per ACR and ICRP criteria, exposures up to 100 mGy, should not be considered for termination of pregnancy.

SSA23-07 Influence of Different Iodinated Contrast Material on the Induction of DNA Damage by Cardiac CT

Sunday, Dec. 1 11:45AM - 11:55AM Room: S502AB

Participants
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PURPOSE

The purpose of this study was to assess the influence of different iodinated contrast materials on the induction of DNA damages and chromosome aberrations in peripheral blood lymphocytes after a cardiac CT examination.

METHOD AND MATERIALS

We obtained institutional review board approval and the written informed consent from 39 patients, who were prospectively enrolled in this study. All patients underwent contrast-enhanced cardiac CT examination. The type of contrast materials administrated to each patient was selected from iomeprol, iopamidol, and iopromide based on clinical decision. Blood samples were obtained before and 15 min after CT scan. The number of γ-H2AX foci, maker of DNA damages, and chromosome aberrations in lymphocytes was quantified by immunofluorescent staining of γ-H2AX and by fluorescence in situ hybridization using PNA probes, respectively. Significant differences between the number of foci were tested by using Kruskal-wallis test.

RESULTS

Iomeprol, iopamidol, or iopromide was applied to 13, 20, 6 patients, respectively. There were no significant difference in the patient characteristics and radiation dose of each group, except patient body weight which was considered for the selection of contrast materials. There were no significant difference in the DLP standardized increment of γH2AX foci and chromosome aberrations (p= 0.55 and p=0.37, respectively).

CONCLUSION

There were no significant difference in the increment of DNA damages and chromosome aberrations by cardiac CT scan with three different iodinated contrast material.

CLINICAL RELEVANCE/APPLICATION

The difference of contrast materials did not affect the enhancement of DNA damage by CT scan.

SSA23-08 Assessment of DNA Damage Induced by Different Tube Voltage CT Scan Using γH2AX Focus Assay

Sunday, Dec. 1 11:55AM - 12:05PM Room: S502AB

Participants
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PURPOSE

The purpose of this study was to assess the effect of CT examination with different tube voltage on the induction of DNA damages in peripheral blood lymphocytes.

METHOD AND MATERIALS

We obtained blood samples from five healthy volunteers. Each sample was divided and exposed to CT scans at a sham (0 mGy), low-dose (10 mGy), standard-dose (40 mGy), or high-dose (200 mGy) with different tube voltages (80, 100, 120, and 135 kVp). To equalize the exposed dose at different tube voltages, we adjusted the scan parameters by using a dosimeter. After irradiation, lymphocytes were isolated and subjected to immunofluorescent staining using anti-γH2AX antibodies. The number of γH2AX foci in at least 4,000 lymphocytes was counted automatically with fluorescence microscopy. Significant differences between the numbers of foci were tested by using Friedman test.

RESULTS

The number of γH2AX foci were significantly increased from baseline level after standard- and high-dose exposure. The difference of tube voltages did not affect the increase of γH2AX foci at low- and standard-dose exposure. At high-dose exposure, the increase of γH2AX foci with 135 kVp was significantly higher than those with 80 and 100 kVp.

CONCLUSION

There was a significant difference at the higher dose exposure than clinical usage. The difference of tube voltage, however, did not affect the increase of γH2AX foci after exposure within the dose range in common clinical settings.

CLINICAL RELEVANCE/APPLICATION

Our results may support the safety of low tube voltage CT scan.

SSA23-09 Explore Immunological Biomarkers by Low Dose Radiation Exposure: Preliminary Results in Animal

Study

Sunday, Dec. 1 12:05PM - 12:15PM Room: S502AB

Participants
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Hyewon Oh, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yong Eun Chung, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To explore immunological biomarkers by low dose radiation exposure in animal experiment

METHOD AND MATERIALS

Five- to seven-week-old male BALB/C mice were irradiated with different doses (0.1, 0.5, 1, 2 Gy) using irradiator x-rad 320 (Precision, USA). Mice were sacrificed 0.5, 12, 24, and 48 hours (hr) after irradiation and the spleen was harvested. Lymphocytes were isolated from the spleen and DNA double strand break down (DSB) was assessed by immunohistochemistry of r-H2A.X. Cell viability was assessed by CCK-8 assay according to exposed radiation dose and time lapse from the irradiation. Inflammatory cytokines including interleukin 6 (IL-6), IL-1a and tumor necrosis factor a (TNF-a) were measured with real time PCR. Statistical analysis was performed with Kruskal-Wallis test and P value greater than 0.05 was considered as statistically significant.

RESULTS

The number of DSB in DNA increased as increasing exposed radiation dose (1.8±0.8 in 0.1 Gy, 3.8±1.5 in 0.5 Gy, 5.7±1.3 in 1 Gy, 10±3.1 in 2 Gy, $P<0.001$, compared to control: 1.0). Cell viability was significantly reduced as increasing exposed radiation dose ($P<0.01$). The decrease in cell viability was 48 hr less than 12 and 24 hr after irradiation, possibly due to proliferation of viable cells. IL-6 level was significantly increased even after lowest dose exposure (0.1 Gy) both in 24 and 48 hr after irradiation (0.1 Gy:0.5 Gy:1 Gy:2 Gy; 2.0±0.5: 2.6±0.2: 2.3±0.2: 2.0±0.8 in 24 hr; 1.7±0.4: 1.8±0.6: 2.0±0.4: 3.0±0.6 in 48 hr, compared to control: 1.0), whereas TNF- a was significantly increased only when the cells were exposed to 2 Gy of radiation (1.6±0.6 in 24hr; 1.9±0.4 in 48 hr, compared to control: 1.0). There was no significant difference in IL-1a compared to control at all irradiated doses and elapsed time after irradiation.

CONCLUSION

Pro-inflammatory cytokine IL-6 can be a biomarker of DNA damage to low dose radiation exposure.

CLINICAL RELEVANCE/APPLICATION

IL-6 can be used as a biomarker for monitoring of DNA damage caused by low dose radiation exposure during the development of radiation protection strategies

Printed on: 10/29/20

SSA24

Vascular/Interventional (Liver Cancer Science)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S404CD

CH CT IR SQ VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
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Amy C. Taylor, MD, Little Rock, AR (*Moderator*) Nothing to Disclose

Sub-Events

SSA24-01 Safety of Shortened Observation Time Without Radiographic Follow-Up for Patients After CT-Guided Lung Biopsy

Sunday, Dec. 1 10:45AM - 10:55AM Room: S404CD

Participants
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Olga R. Brook, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Bettina Siewert, MD, Boston, MA (*Abstract Co-Author*) Editor, Wolters Kluwer nv; Reviewer, Wolters Kluwer nv;
Muneeb Ahmed, MD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company Stockholder, Agile Devices, Inc Scientific Advisory Board, Agile Devices, Inc

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PURPOSE

To determine safety of shortened observation without follow up chest X-ray (CXR) after CT-guided lung biopsy in patients without immediate post-procedure pneumothorax (PTX).

METHOD AND MATERIALS

Consecutive patients that underwent CT-guided lung biopsies under moderate sedation between 01/05/2015 and 06/19/2017 in a tertiary academic center were included in this IRB-approved HIPAA-compliant study. "Immediate post-procedure PTX" was defined as one detected by CT at the end of the biopsy; "observation PTX" and "delayed PTX" defined as pneumothorax detected by CXR during and after the post-procedural monitoring period, respectively.

RESULTS

441 lung biopsies for 409 patients (average age 68 ± 11yrs, 231 (56%) female patients) were performed; 76 biopsies were excluded due to immediate post-procedure PTX, 6 due to insufficient documentation in the electronic medical records and 6 due to lack of follow up after biopsy. Average duration of monitoring for outpatients (n=293) was 2.01 ± 0.74 hrs . In 20/353 (5.7%) biopsies, the patient became symptomatic (chest pain, shortness of breath) during post-procedural observation with 1/20 (5%) developing PTX. In 313/333 biopsies, the asymptomatic patients did not undergo CXR after the procedure, with 7/309 of these patients (2.3%) developing delayed PTX 2-10 days after the procedure (average 4.9 ± 4.0 days). In 24/333 biopsies (7.2%), the asymptomatic patients underwent CXR within 4 hours with no PTX detected and despite that 1/24 of these patients (4.2%) presented with delayed PTX 7 days after the procedure. When no immediate post procedural PTX was present, the rate of observation PTX and delayed PTX was 1/353 (0.3%) and 8/353 (2.3%), respectively.

CONCLUSION

Obtaining routine post-procedure CXRs in patients without immediate post-procedural PTX after CT-guided lung biopsies is not necessary given the low likelihood of PTX. Furthermore, shortening monitoring to 2 hour appears to be safe for these patients.

CLINICAL RELEVANCE/APPLICATION

A decrease in observation time for these subset of patients will allow improved utilization of hospital resources.

SSA24-02 Transthoracic Ultrasound Guided Lung Biopsy: Accuracy and Safety

Sunday, Dec. 1 10:55AM - 11:05AM Room: S404CD

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PURPOSE

Variables affecting performance of ultrasound-guided transthoracic needle biopsy (USG-TTNB) are not well established. The aim is to determine the clinical and imagery variables affecting sensitivity and rate of complications with USG-TTNB.

METHOD AND MATERIALS

From 2008 to 2017, a total of 542 consecutive USG-TTNB were reviewed. Mediastinal and chest wall lesions were excluded. 14 patients had incomplete data. Cubic splines were used to test the functional relationship between pleural contact length with sensitivity and complications. Multivariate logistic regression was used to account for possible confounding variables on that relationship.

RESULTS

Of the 528 biopsies, 312 diagnosis were obtained by USG-TTNB, including 285 malignant and 27 specific benign diagnosis, yielding a diagnostic accuracy of 59.2% (95%CI 54-62%) and sensitivity of 72.5% (95%CI 68-77%), respectively. Positive biopsies were associated with lesion size (p<0.001), pleural contact length (p<0.006), absence of pneumothorax (p=0.001), chest wall invasion (p=0.005) and core biopsy needle <=18G versus >18G (p=0.024). Graphical inspection of a cubic spline showed that the probability of positive biopsies rose sharply for increasing pleural contact length up to 30 mm, then a flattening of risk. A similar reverse relationship was observed for pneumothorax. After adjusting for lesion size, chest wall invasion, and core biopsy needle, there was a significant effect of increasing pleural contact length up to 30 mm predicting positive biopsy (HR 1.07 {1.02, 1.12}, p=.002 per 1mm) with a non-significant effect of pleural contact size past 30 mm. Pneumothorax occurred in 14.6% (95%CI 11.7-17.9%) and chest tube was placed in 1.7% (95%CI 0.8-3.2). Variables associated with pneumothorax were lesion size (p<0.001), pleural contact length (p<0.001) and upper/middle lobes (p=0.002). On multivariate analysis, none of the above were significant at 5% level. No variables were associated with hemorrhagic complications, which occurred in in 3.3% (95%CI 1.8-4.8).

CONCLUSION

Pleural contact length and target lesion size were the key variables predicting diagnostic accuracy and pneumothorax rate.

CLINICAL RELEVANCE/APPLICATION

Efficacy and safety outcomes are both affected by pleural contact length and lesion size. Therefore, choosing US-TTNB as a diagnostic procedure must consider these variables.

SSA24-03 Ultrasound- versus CT-Guided Peripheral Lung Biopsies: A Comparison of Safety, Effectiveness, and Wait Times

Sunday, Dec. 1 11:05AM - 11:15AM Room: S404CD

Participants
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PURPOSE

To compare the safety, effectiveness and wait times of CT-guided percutaneous lung biopsies with ultrasound (US) guidance for peripheral lung lesions that abut or arise from the pleura.

METHOD AND MATERIALS

Consecutive CT- and US-guided biopsies performed at our institution between January 2017-January 2019 were retrospectively reviewed. Lesion size, the degree of pleural contact, wait time for the procedure, the number of needle passes, procedure duration, complications and final pathology diagnosis were recorded. Chi-square and Mann-Whitney U tests were used for statistical analysis. Research ethics board approval was obtained.

RESULTS

A total of 228 imaging-guided lung biopsies were performed by 5 interventional radiologists. Of these, 117 were for peripheral or pleural-based lesions. US guidance was used for 38 cases (20 men, 18 women, mean age 71.1). CT guidance was used for 70 cases (39 men, 40 women, mean age 69.9). Overall, the mean maximum axial diameter of pulmonary lesions sampled under US guidance was greater than for CT (4.8±2.5 cm vs 3.7±1.8 cm, p = 0.007). Similarly, the length of pleural contact was also greater for US (4.1±2.4 cm) than CT (2.6±1.7 cm, p < 0.001). Procedure time was shorter for lesions localized with US than CT (28.7±16.9 min vs 36.6±20.2 min, p = 0.017). In contrast, the mean number of needle passes per lesion was less for CT than US (3.1±0.9 vs 3.5±1.1, p = 0.019). The adequacy of biopsy samples was determined to be equivalent for both modalities (97.4% for US and 97.5% for CT). The wait time for both procedures was not significantly different (11.7±8.3 days for US vs 14.9±8.0 days for CT, p = 0.059). Finally, the frequency of significant complications requiring chest tube insertion and/or hospital admission was similar between US and CT (2.6% vs 3.8%).

CONCLUSION

US-guided peripheral lung biopsies are safe and reliable with comparable results to CT-guided biopsies and similar wait times, but

US-guided peripheral lung biopsies are safe and reliable with comparable results to CT-guided biopsies and similar wait times, but shorter procedure times.

CLINICAL RELEVANCE/APPLICATION

US is relatively low cost, does not require ionizing radiation and allows for real-time needle visualization, making it a viable alternative to CT guidance for biopsy of peripheral lung lesions.

SSA24-04 CT-Guided Percutaneous Biopsy of Ever Smaller Lung Nodules: Diagnostic Yield and Complication Rate as a Function of Nodule Size

Sunday, Dec. 1 11:15AM - 11:25AM Room: S404CD

Participants
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PURPOSE

The number of CT-guided percutaneous lung biopsies performed is rapidly growning, in part due to the advent of lung cancer screening CT. However, not only are we performing more lung biopsies, but we are biopsying ever smaller nodules. Given that subcentimeter nodules have not routinely been biopsied, the diagnostic yield and complication rates are not known. The purpose of this project was to evaluate the diagnostic yield and complication rate of percutaneous lung biopsy as a function of nodule size.

METHOD AND MATERIALS

This IRB approved study involved retrospective review of 625 patients who underwent percutaneous, CT-guided lung biopsy. Patients were identified via search of our electronic medical records system (Montage). Biopsies were performed by one of fifteen attending radiologists specializing either in interventional radiology or body imaging. Data recorded included nodule size, distance from the pleura, needle type, number of passes peformed, pneumothorax rate, chest tube rate, hospital admission rate, diagnostic yield as well as history of smoking or prior malignancy.

RESULTS

Overall, a diagnostic specimen was obtained in 91.5% of patients (572/625). However, diagnotic yield for lesions <1 was 80% compared to 92.1% for nodules > 1 cm ($p < 0.05$). For every 1 cm increase in lesion size, the odds of achieving a diagnsotic specimen increased 21% ($p < 0.05$). Pneumothorax complicated 11% of biopsies (69/625) and 5.6% of patients (35/625) required chest tube placement. However, 22.5% of procedures were complicated by pneumothorax when lesions were <1 cm, compared to 10.3% of procedures when the nodule was >1 cm ($p < 0.05$). For every 1 cm increase in nodule size, the odds of pneumothorax decreased 24% ($p < 0.05$). Although there was no statistically significant difference in patients requiring chest tubes in the two groups, the odds of requiring a chest tube decreased 21% for ever 1 cm increase in lesion size ($p < 0.05$).

CONCLUSION

Percutaneous CT-guided lung biopsy is a safe and effective procedure, however the diagnsotic yield decreases and the complication rate increases as the size of the biopsy target decreases.

CLINICAL RELEVANCE/APPLICATION

As the number of CT-guided lung biopsies increases across the country it is crucial that physicians and patients understand that diagnostic yield and complication rates are directly related to nodule size.

SSA24-05 Efficacy of Thermal Ablation versus Stereotactic Radiotherapy for Stage I Lung Cancer: Subgroup Analyses Based on Tumor Histology

Sunday, Dec. 1 11:25AM - 11:35AM Room: S404CD

Participants
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PURPOSE

To assess the effectiveness of thermal ablation (TA) versus stereotactic body radiotherapy (SBRT) for stage I lung cancer depending on histology.

METHOD AND MATERIALS

The National Cancer Database was queried for patients with AJCC stage I lung cancer diagnosed from 2004-2015. Adenocarcinoma, squamous cell carcinoma (SCC), unspecified non-small cell lung cancer (NSCLC) und other histology (except carcinoid) were included. Treatment was stratified as TA (radiofrequency ablation, or grouped laser/cryo ablation) and SBRT (beam-based radiation of the lung). Patients age < 18yo, chemotherapy, and unknown survival /follow up were excluded. SBRT and TA patients were 5:1 propensity score matched to account for confounders, separately for each histology. Overall survival (OS) was compared in the matched cohort.

RESULTS

55,336 patients were included: n=68,693 receiving SBRT (97.3%) and n=1,836 receiving TA (2.7%). Histology was adenocarcinoma n=24,085 (35.1%), SCC n=20,736 (30.2%), NSCLC n=10,515 (15.3%), and other histology n=13,357 (19.4%). TA patients were more likely to be younger Caucasians with private insurance and more comorbidities and treated at academic centers in New England states for smaller adenocarcinomas.For each histology, a matched cohort was obtained with balanced distribution of confounders. TA and SBRT demonstrated comparable OS in all subgroups: adenocarcinoma (p=0.297; 1-year OS: 86 vs 86%; 3-year OS: 49 vs 52%), SCC (p=0.086; 1-year OS: 67 vs 67%; 3-year OS: 27 vs 30%), NSCLC (p=0.732; 1-year OS: 83 vs 83%; 3-year OS: 49 vs 47%), and other histologies (p=0.094; 1-year OS: 85 vs 83%; 3-year OS: 59 vs 50%).

CONCLUSION

Utilization of thermal ablation techniques for stage 1 lung cancer varies with tumor and patient variables. For adenocarcinomas, squamous cell carcinomas and tumors classified as unspecified NSCLC, overall survival was comparable for TA and SBRT. Future studies should prospectively evaluate optimal patient selection criteria in stage I lung cancer to offer individualized treatment approaches.

CLINICAL RELEVANCE/APPLICATION

Thermal ablation shows comparable OS to SBRT in stage I lung cancer and should be considered as an alternative treatment option, independent of histological subtype.

SSA24-06 Percutaneous Cryoablation of Lung Metastasis:15 Year Experience of Feasibility, Safety and Recurrence Parameters

Sunday, Dec. 1 11:35AM - 11:45AM Room: S404CD

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PURPOSE

To report our long-term experience with CT guided percutaneous cryoablation using intensive freeze parameters for lung metastasis, including factors affecting complications and local recurrence rates.

METHOD AND MATERIALS

Following IRB approval under HIPAA compliance, 192 CT fluoroscopic-guided, percutaneous cryoablation procedures were performed for 262 masses in 107 outpatients. Primary sites of lung metastasis included colorectal (N=57), renal cell carcinoma (N=38), sarcoma (N=103), gynecologic (N=17), hepatobiliary (N=8) and other (N=24). Tumor size and location (central vs peripheral) with relationship to major vasculature. Hydrodissection and/or were utilized for protection of adjacent structures (ie: esophagus). All complications were graded according to standardized CTCAE criteria. Patients were followed by CT and/or MRI at 1, 3, 6, 12, 18, 24 months and yearly thereafter.

RESULTS

Average tumor diameter of 2.0 cm was treated by average cryoprobe number of 3.1, which produced CT-visible ice ablation zone diameters averaging 4.1 cm. Grade >3 complications were 3.6% [N=7/192]. There were greater complications in tumors greater/less than 3 cm [9.8% (4/41) vs. 2.0%(3/151)], p<0.025). No deaths occurred in our series for ablation of metastatic lesions. Hydrodissection and/or warming catheter utilization was used in 7.8% (15/192). At a mean follow-up of 24 months, overall local tumor recurrence was 5.7%(15/262), but significantly greater for tumors above 3cm (i.e.,16% (7/44); p<0.005).

CONCLUSION

With appropriate pretreatment evaluation and PFT criteria, percutaneous lung cryoablation is safe and produces very low local recurrence rates, especially for tumors <3 cm.

CLINICAL RELEVANCE/APPLICATION

Appropriately delivered thoracic metastasis cryoablation is affected by tumor size yet still produces low recurrence and complication rates.

SSA24-07 Innovative Technique for CT-Guided Presurgical Lung Nodule Marking: High Efficacy and Safety

Sunday, Dec. 1 11:45AM - 11:55AM Room: S404CD

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PURPOSE

To assess outcomes of CT-guided localization for preoperative lung nodule marking prior to video-assisted thoracoscopic surgery and robotic video-assisted thoracoscopic surgery.

METHOD AND MATERIALS

25 CT-guided lung nodule localization procedures were performed on 26 nodules in 25 patients prior to surgical resection. The procedures were performed by a fellowship trained radiologist 1 to 2 hours prior to scheduled surgery under local anesthesia. Approximately 4 to 6 ml of methylene blue/collagen solution was injected in a perinodular location under CT-guidance with a 19g trocar needle. Post procedure CT images with increased perinodular consolidation confirmed appropriate marking. Patients were then transferred back to surgery.

RESULTS

Accurate perinodular CT- guided needle trocar placement was achieved in all marking procedures. Increased perinodular consolidation was also demonstrated in all patients on the post procedural localized CT scans. One patient with moderate emphysema developed a small to moderate sized pneumothorax and a 8F thoracentesis catheter was placed under CT guidance prior to return to surgery. There was no noted bleeding or hemoptysis in any of the patients. Methylene blue/collagen solution was readily visible by the thoracic surgeon in association with all target nodules. One patient required conversion to open procedure due to advanced disease. Of the 26 identified nodules, pathology specimens confirmed adequacy of nodule resection in all cases.

CONCLUSION

Intraoperative identification of pulmonary nodules/ tumors, especially deep nodules and patients undergoing VATS or robotic surgery, may be challenging. Perinodular localization by CT guided methylene blue/ collagen solution injection offers a safe technique with high efficacy.

CLINICAL RELEVANCE/APPLICATION

CT-guided methylene blue/ collagen localization allows thoracic surgeons to readily identify nodules/tumors, improve outcomes and decrease morbidity in patients undergoing thoracic surgery.

SSA24-08 Percutaneous CT-Guided Microwave Ablation of Non-Operable Pulmonary Metastases: Role of Apparent Diffusion Coefficient in Assessment Early Treatment Response

Sunday, Dec. 1 11:55AM - 12:05PM Room: S404CD

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PURPOSE

To determine retrospectively the early treatment response of MWA in patients with pulmonary metastases using Apparent diffusion coefficient(ADC) value.

METHOD AND MATERIALS

51 patients with 76 lung metastatic lesions were included &treated with MWA according to the guidelines. lesions were evaluated by diffusion weighted imaging (DWI) and ADC value before and 24 hours after MWA. DWI was obtained with b-values (50,400, 800:mm2/s) using 1.5& 3 tesla MRI. Postablation follow-up by chest CT and/or MRI with ADC value measurement was done after 24 hours, 3, 6 months, 1 year and every 6 months onwards to determine responsive and local progression cases with residual tumor activity.Immediate postablation changes in ADC values were compared to the net response based on CT and/or MRI follow-up

RESULTS

50 lesions(65.8%) showed complete response to treatment and 24 lesions(34.2%)with local progression.We reported statistical significance difference of ADC value measured 24 hours after ablation between the responding(1.7 ± 0.2x 10-3 mm2/s) and non-responding groups(1.4 ± 0.2x10 0-3 mm2/s) with significant relatively higher values at the former(P0.001); a cut-off ADC value (1.41) has been suggested as reference point to predict the response (66.65% Sensitivity, 84.22%Specificity, 66.72%PPV& 84.21%NPV). No significant difference of ADC value performed before the ablation as a prognostic factor for the response (P0.85). No significant difference in post- ablation ADC values of different types of pulmonary metastases (P 0.321)

CONCLUSION

ADC value calculated 24 hours post-treatment is a good quantitative measurement that may allow early prediction of the treatment efficacy of MWA of pulmonary metastases before changes in tumor size become detectable on Conventional CT or MRI.

CLINICAL RELEVANCE/APPLICATION

ADC can evaluate early MWA efficacy in treatment of pulmonary tumors and Can predict tumor recurrence after treatment.

ADC can evaluate early TACE efficacy in treatment of pulmonary tumors and can predict tumor recurrence after treatment.

SSA24-09 Palliative Role of Non-Selective Intra-Aortic Transarterial Chemoperfusion (TACP) in the Management of Inoperable Cases of Advanced Lung Cancer

Sunday, Dec. 1 12:05PM - 12:15PM Room: S404CD

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PURPOSE

To evaluate the initial tumor response, local control, and survival after the treatment of primary lung malignancies using non-selective intra-aortic transarterial chemoperfusion (TACP) in palliative intent.

METHOD AND MATERIALS

Forty-two patients (mean: 63±11 years; 19 females and 23 males) with advanced unresectable lung cancer (stage III=8 & stage IV=34), underwent repetitive TACP, as third- or further-line therapy, between November 2006 and January 2016. The mean number of sessions was 5.3±2.5. The treated pathologies were non-small cell lung cancer (n=29), small cell lung cancer (n=1) and 12 cases of bronchogenic carcinoma with unknown histology. Bilateral lung involvement was present in 61.9% of cases and the median number of lesions was four. Regional delivery was achieved by injecting the chemotherapeutic agents intra-aortic, as a bolus with maximum hand pressure, in close vicinity to the origins of the main tumor-supplying arteries. The treatment regimen included a combination of mitomycin C and Gemcitabine with (n=37) or without cisplatin (n= 3). Two patients received other combinations after their oncologists' recommendations. The treatment was performed in a palliative setting and patients who underwent subsequent ablation were excluded. The response was evaluated according to the revised RECIST criteria and local tumor progression and patient survival were analyzed using the Kaplan-Meier estimator.

RESULTS

Partial response (PR) was achieved in 4.8% (n=2), stable disease (SD) in 69% (n=29) and progressive disease (PD) in 26.2% (n=11). The estimated mean survival time (MST), median survival time and mean and median time to progression were 20±5.5, 9.5±0.6, 10.7±1.8 and 6.7±2.2 months, respectively. Technical success was achieved in all patients and no intervention-related complications were recorded.

CONCLUSION

Transarterial chemoperfusion is a feasible and well-tolerated treatment in patients with advanced lung cancer who failed prior systemic chemotherapy and have the potential to improve local control and survival, when compared to the published results of other third - and further-line therapies.

CLINICAL RELEVANCE/APPLICATION

TACP is a minimally invasive treatment option that can positively affect the local control and survival in patients with advanced lung cancer.

SSA25

Vascular/Interventional (Embolization)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S405AB

IR VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
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Sub-Events

SSA25-01 Hepatic Pseudoaneurysm Formation after Blunt and Penetrating Traumatic Liver Injury: A Level 1 Trauma Centre Experience

Sunday, Dec. 1 10:45AM - 10:55AM Room: S405AB

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PURPOSE

At our institution, we have developed an imaging protocol for liver injury patients which involves repeat computed tomographic (CT) angiography of the liver at 48-72 hours to assess specifically for HPAs. The purpose of this study was to evaluate the utility of our imaging pathway in liver trauma with a focus on detection of hepatic pseudoaneurysms (HPAs).

METHOD AND MATERIALS

A retrospective analysis was performed on patients who were admitted to St Mary's Hospital, London over a four-year period found to have either blunt or penetrating liver injury on initial CT imagining. Data collection included initial and follow-up CT findings, mechanism of injury, injury severity score (ISS), American Association for the Surgery of Trauma (AAST) liver injury score and further intervention.

RESULTS

Between January 2014 and January 2018, 149 major trauma patients were admitted with liver injuries (mean age 35.6 years; 72% male, 28% female). 72% patients suffered blunt (mean ISS=27.2; mean AAST=2.89) and 28% patients suffered penetrating injuries (mean ISS=26.9; mean AAST=2.88). Mean time to follow up CT was 46.05 hours. Follow-up CT identified 8 HPAs (62.5% blunt vs 37.5% penetrating injuries) and 1 (0.671%) arteriovenous malformation. 6 (4.03%) of these patients were treated with embolisation. ISS and AAST did not predict pseudoaneurysm formation according to logistic regression analysis. ISS (OR 1.06 [1.02, 1.09; p=0.002]) and AAST (OR 2.24, [1.31, 3.83; p=0.003]) were predictors of requirement for embolisation.

CONCLUSION

Our experience indicates a role for early detection of HPAs using a dedicated trauma imaging pathway. Interestingly, ISS and AAST are predictors for patients who will undergo interventional radiology procedures and could be used to stratify patients who should be planned for interventional procedures.

CLINICAL RELEVANCE/APPLICATION

Hepatic pseudoaneurysm (HPA) is a rare but potentially life-threatening sequelae of blunt or penetrating liver trauma.

SSA25-02 Performance of a Novel, Bioengineered, Retrievable Endovascular Gel Embolic in a Swine Model: Long Term Survival Data

Sunday, Dec. 1 10:55AM - 11:05AM Room: S405AB

Participants
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PURPOSE

Coil embolization is used today to treat hemorrhage resulting from trauma, aneurysm rupture, or bleeding tumor. However, these coils are often ineffective in a state of anticoagulation. The purpose of this study was to study the long term effects of embolization using a bioengineered gel embolic material in a swine model.

METHOD AND MATERIALS

Yorkshire pigs weighing 50-60kg were used and anticoagulated with IV heparin (ACT 250-500). Briefly, via carotid artery access under US guidance, a catheter was delivered to the pelvic arteries or renal arteries. On one side, coil embolization was performed. On the other side, approximately 3 cc of the embolic material was injected. On day of sacrifice, Day 0, Day 7, Day 14 and Day 28, all animals underwent CTA using a Force CT scanner and embolized arteries were harvested and histology was performed. CBC, Chem-7, coagulation tests, cytokine arrays were performed pre and post embolization. Extensive image analysis was performed using standard CT scanner and a high resolution micro-CT scanner.

RESULTS

Arteries embolized with all types of coils demonstrated persistent flow. Arteries embolized with 3 cc of biomaterials achieved instant hemostasis and complete embolization regardless of anticoagulation state. Injection of 1-2 cc of biomaterial to the coiled arteries was able to rescue and achieve instant hemostasis. In addition, injected biomaterial could be successfully retrieved. Embolization with biomaterial was 40X faster than with coils ($P<0.05$). Histology of the embolized arteries demonstrated complete filling of the artery; however, there was progressive biodegradation of the biomaterial over time with its replacement with fibrotic tissue. CBC and chemistry labs as well as inflammatory markers were not significantly different pre and post embolization ($P<0.05$). Scanning electron microscope images, micro-CT and CT analysis of the embolized arteries showed absence of recanalization of the biomaterial.

CONCLUSION

Novel gel embolic outperforms coil technologies in every aspect tested. Biomaterials can also be retrieved suggesting that temporary embolization could be possible.

CLINICAL RELEVANCE/APPLICATION

We present data on >130 embolized swine arteries and demonstrate its superiority over coils and their efficacy. This biocompatible biomaterial is also easy to deliver and easy to use compared to coils.

SSA25-03 Selective Bariatric Arterial Embolization with Calibrated 100-200 µm Radiopaque Microspheres Suppresses Weight Gain in Swine

Sunday, Dec. 1 11:05AM - 11:15AM Room: S405AB

Participants
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PURPOSE

To assess whether calibrated radiopaque microspheres used for bariatric arterial embolization (BAE) enable fundal coverage assessment and weight gain suppression over an 8-week period in swine.

METHOD AND MATERIALS

BAE was performed in 5 healthy swine (~23kg) under X-ray guidance by selective infusion of calibrated 100-200 µm radiopaque microsphere (BTG) into the left gastroepiploic artery and right gastric artery. Control pigs (n=3) underwent a sham procedure. Weight was obtained at baseline and weekly until 8 weeks after embolization. Cone beam CT (CBCT) images of the stomachs were acquired immediately after embolization, at 8 weeks prior to sacrifice and postmortem to examine the persistence of embolic microspheres. Endoscopy was performed at 1-2 weeks after embolization to examine mucosal ulceration. Plasma ghrelin levels were assessed using a radioimmunoassay.

RESULTS

BAE with radiopaque microspheres was technically feasible in all embolized animals with the visualization of microspheres on both X-ray and CBCT during the procedure and up to 8 weeks after embolization. Superficial mild mucosal ulcers restricted mainly to the stomach fundus and body were noted in all BAE pigs. One BAE animal had minimal embolics delivered in the fundus as assessed by CBCTs with concurrent normal weight gain as control pigs. Overall, a significant reduction of the percentage of weight gain was noted in embolized pigs as compared to controls (42.3% ± 5.7 BAE vs. 51.6% ± 2.9 controls, $p=0.04$). Similarly, the plasma ghrelin levels of embolized animals were significantly lower than those of controls (1709 ± 172 BAE vs. 4343 ± 1555 controls at 8 weeks, $p<0.01$).

CONCLUSION

The radiopacity of the embolics enabled qualitative assessment of the fundal coverage. The significantly suppressed percentages of

weight gain and systemic plasma ghrelin levels suggests that the calibrated 100-200 µm microspheres may be the optimal embolics for effective weight management via BAE.

CLINICAL RELEVANCE/APPLICATION

Calibrated radiopaque microspheres could facilitate image-guided BAE for treating obesity.

SSA25-04 Digital Subtraction Angiography versus Digital Variance Angiography for Image Guidance of Prostatic Artery Embolization (PAE)

Sunday, Dec. 1 11:15AM - 11:25AM Room: S405AB

Participants
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PURPOSE

Kinetic imaging is defined as a novel X-ray image processing method for the visualization of contrast motion. The algorithm produces so-called Digital Variance Angiography (DVA) images. The study objective was to compare the performance of DVA versus standard digital subtraction angiography (DSA) for vascular intervention in Prostatic Artery Embolization (PAE) of benign prostatic hyperplasia.

METHOD AND MATERIALS

81 angiographic acquisitions of 26 patients (mean age 67.47, SD 9.76, range 42-82) undergoing PAE at our institution were evaluated. Signal-to-noise ratio (SNR) of DSA and DVA pairs was compared using regions of interest. Comparison of clinical image quality was performed by three experienced interventional radiologists in a randomized blinded trial comparing the DSA- and DVA-videos, using a 5-point-Likert-scale consisting of clinically relevant criteria (e.g. visibility of feeding- and collateral-branches, size of examinable arteries). Fleiss' kappa-test was used to determine interrater agreement.

RESULTS

DVA images provided 1.79 times higher SNR than DSA (median value, Q1-Q3 interval was 1.46-2- 32). The visual evaluation indicated that DVA-videos provided higher quality images than DSA-videos, since in 80.6% of comparisons evaluators preferred DVA over DSA. The interrater agreement was 83.8% and Fleiss's kappa was 0.38 ($p<0.001$).

CONCLUSION

In PAE setting, DVA-imaging enhances visualization of anatomical structures, compared to DSA- imaging, via significant SNR increase, thereby the new technology might improve the safety and efficacy of the intervention. As an additional advantage, the observed quality reserve of DVA might provide opportunity also for the reduction of radiation-dose and the amount of contrast agent, as an attempt to solve these major issues related to PAE procedures.

CLINICAL RELEVANCE/APPLICATION

DVA may improve safety and confidence during PAE interventions, by reducing image-noise and enhancing the visibility of small vascular structures, thus facilitating the reduction of radiation-dose and contrast agent, which is one of the major concerns for safety of PAE interventions.

SSA25-06 Detection of Reperfused Pulmonary Arteriovenous Malformations on Dynamic Ultrafast Contrast Enhanced Magnetic-Resonance-Angiography (MRA) and High Resolution Static CE MRA

Sunday, Dec. 1 11:35AM - 11:45AM Room: S405AB

Participants
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PURPOSE

The recommended treatment of pulmonary AV-Malformations in patients with HHT (Osler disease) is catheter embolization using platinum coils or vascular plugs. However, in up to 30 percent of patients, reperfusion may occur due to opening of collateral vessels or reopening of the treated vessel itself.The aim of our study was to investigate patients post treatment of pulmonary

AVM's for possible reperfusion using dynamic and high resolution CE MRA.

METHOD AND MATERIALS

72 patients with previous treatment of PAVMs by either coil embolization or implantation of Amplatzer vascular plugs underwent follow-up studies for detection of reperfused PAVM by contrast enhanced MRA. A time-resolved MRA-study was performed with injection of a small contrast medium bolus (0.025 mmol/kg BW MultiHance, Bracco). The temporal resolution of the sequence was < 3 sec/dataset with a total number of 72 slices. Thereafter a high resolution CE MRA (0.075 mmol/kg BW MultiHance) was performed. Images were evaluated regarding enhancement of the AVM and if detected, time of enhancement of the draining vein was further evaluated.

RESULTS

In 22 pts 33 reperfused PAVM were diagnosed based on both time-resolved and high-resolution MRA. If findings were unclear on high resolution images, evaluation of the enhancement kinetics of the draining vein was helpful to distinguish between retrograde filling, filling of the still dilated draining vein via normal lung tissue and reperfusion by reopening of shunt vessels or new collateral supply. All reperfused PAVM were confirmed by DSA and underwent reembolization. The mean diameter of reperfused vessels was 4.5 mm (SD 1.4). Reperfusion was detected both after coil embolization and implantation of Amplatzer vascular plug 4. Interestingly reperfusion may even occur after longer time intervals of completely occluded vessels.

CONCLUSION

Contrast-enhanced MR-Angiography can reliably depict reperfusion / recanalization of treated PAVM. Reperfusion might even occur after longer time intervals after initial complete occlusion, thus regular follow-up studies are mandatory.

CLINICAL RELEVANCE/APPLICATION

Reperfusion of PAVM can occur in up to 30 percent of cases and early detection is mandatory to avoidcomplications. Dynamic CE MRA directly depicts early enhancement of the draining vein as a sign ofreperfusion and thus can give important additional information not gained in conventional acquisitions or CT.

SSA25-07 Quantitative 2D DSA: A Novel Method for Determining Treatment Endpoints during Transarterial Embolization

Sunday, Dec. 1 11:45AM - 11:55AM Room: S405AB

Participants
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PURPOSE

Treatment endpoints during transarterial embolization (TAE) are subjective and rely on visual recognition of contrast stasis post-embolization. 2D DSA provides the necessary spatial resolution and dynamic contrast information to visualize the hepatic vasculature during liver-directed therapies. This study sought to evaluate temporal 2D DSA velocity variations and contrast stasis post injection as quantitative endpoints during TAE.

METHOD AND MATERIALS

A left hepatic TAE was performed to complete stasis on an ~50kg female domestic swine using 100-300 µm microspheres. 2D DSA velocity and pulsatility persistence values (n=3 each per time point) were evaluated on two projection angles before (time point 1), sequentially during (time points 2 & 3) and after TAE (time point 4). For the 2D DSA acquisitions, iodinated contrast medium was injected at 2.5 mL/s for 15 mL with respiration suspended. Velocity was derived from a shifted least-square method that relies on the pulsatility of opacified blood from an intra-arterial iodine injection. Pulsatility persistence (contrast stasis metric) was defined as the time interval between the final left hepatic (LH) contrast peak (50% greater than baseline) and the time of common hepatic artery (CHA) contrast clearance.

RESULTS

Sequential 2D DSA velocity measurements during TAE (time points 2 & 3) decreased on both projection angles. The average variation of velocity was 3.1% for the first 3 time points and 20.4% for the final time point. Velocity was not accurately quantified on the final time point when stasis was achieved due to reflux disturbing the baseline pulsatility. The average contrast clearance time calculated for the CHA was 10.0 ± 0.2 sec. Pulsatility persistence was zero for the first 2 time points, increased on the 3rd time point and was highest on the 4th time point when stasis was reached.

CONCLUSION

2D DSA can provide quantitative measurements of velocity and pulsatility persistence in vivo. A combination of these metrics could help define more objective endpoints during TAE.

CLINICAL RELEVANCE/APPLICATION

2D DSA velocity, when combined with pulsatility persistence post contrast injection, may facilitate development of quantitative endpoints for transarterial embolization.

SSA25-08 Emergency Endovascular Treatments for Delayed Hemorrhage after Pancreaticobiliary Surgery: Indications, Outcomes and Follow-Up of a Retrospective Cohort

Sunday, Dec. 1 11:55AM - 12:05PM Room: S405AB

Participants

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PURPOSE

To evaluate the outcomes of emergency endovascular treatments for delayed bleeding after pancreaticobiliary surgery.

METHOD AND MATERIALS

We retrospectively evaluated 21 patients (M:F=13:8, median age=64 years) undergoing 23 endovascular treatments, performed from 2010 to 2017 in a single center. Data collected were: patient characteristics; surgery; pathology; incidence of postoperative pancreatic fistulas (POPF); bleeding signs on CT and angiography; damaged artery; endovascular tools used; technical and clinical success; intervals between surgery, endovascular treatment and discharge; survival rates. Sixteen patients had pancreatoduodenectomy, three hepaticojejunostomy, two distal pancreatectomy. Indications to surgery were mainly biliary (33%), pancreatic (19%) or duodenal (10%) malignancies.

RESULTS

Seventeen patients had 'grade C' POPF, three suffered a biliary leak, one had no POPF. Active bleeding was present in 17/23 CTs and in 22/23 angiographies, mostly from hepatic (43%), gastroduodenal (22%) and splenic (13%) arteries. Embolizations were performed with coils (26%), glue (22%), stent-graft or vascular prostheses (22%) and their combinations (30%). Sixteen patients had a single endovascular treatment, one underwent a second embolization, three had surgery, one had repeat embolization followed by surgery. Relaparotomy rate was 19%. Median hospital stay was 37 days (range 12-75); median intervals among pancreaticobiliary surgery, endovascular treatment and discharge were 21 (2-36) and 12 (8-47) days, respectively. We observed 4/21 intrahospital deaths (median: 31 days from endovascular treatment, 4-53); one-year survival rate of discharged patients was 71%.

CONCLUSION

In our experience, endovascular treatment using embolization and/or stent-graft placement is a useful first-line intervention to halt postoperative hemorrhage after pancreaticobiliary surgery.

CLINICAL RELEVANCE/APPLICATION

Avoiding hazardous relaparotomy, the endovascular treatment should be considered the first-line intervention for patients suffering from delayed hemorrhage after pancreaticobiliary surgery.

SSA25-09 4D-Cone Beam Computed Tomography(4D-CBCT) for Image Guidance during Prostatic Artery Embolization (PAE): Feasibility and Comparison to Magnetic Resonance Angiography (MRA)

Sunday, Dec. 1 12:05PM - 12:15PM Room: S405AB

Participants
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PURPOSE

To evaluate pelvic 4-Dimensional-ConeBeamComputedTomography (4D-CBCT)-DigitalSubtractionAngiography (DSA) for intraprocedural application of prostatic artery embolization (PAE). Our aim was to test this novel techniques performance against established preinterventional MagneticResonanceAngiography(MRA).

METHOD AND MATERIALS

21 patients(age range: 47-81years; mean: 66years) undergoing PAE at our institution were included. 4D-CBCT volumes were reconstructed from a single contrast-injection 5-second-conebeamCT run, which was using the altered locoregional distribution of contrast-agent between the volumes' single images, to calculate visualization of real-time temporal-resolution DSA. Image-quality of 4D-CBCT was compared by three independent readers to established prostatic MR-angiography in terms of visualization of prostatic vessels, collaterals to neighboring organs, reproducibility of image-quality(IQ) and general, or contralateral, prostatic parenchymal enhancement prior to embolization.

RESULTS

Success rates of MRA-acquisitions in identifying feeding vessels were 17 of 21 versus 28 of 29 4D-CBCT-acquisitions. In 12 patients 4D-CBCT provided additional information compared to MRA, which influenced the treatment decision in 9 cases of 21 patients, by dynamically visualizing crossflow, anatomical variants of prostatic arteries, preventing potential nontarget embolization. Variants in blood-supply were found in 6 patients, multiple feeding prostatic arteries in in 4 patients and contralateral perfusion in 2 patients. Prostatic perfusion was confirmed before embolization for all patients. Spatial resolution of 4D-CBCT was 0.1mm compared to 0.9mm for the MRA.

CONCLUSION

Time-resolved 4D-CBCT is a feasible method to create vascular volumes with exceeding image-quality for PAE-procedures, compared to common MRA and DSA alone. The 4D-CBCTs maximum-intensity-projections' spatial- and temporal-resolution surpasses that of MRA-acquisitions especially with small vessels, such as the prostatic arteries, also with a higher contrast compared to conventional DSA.

CLINICAL RELEVANCE/APPLICATION

4D-CBCT is a novel approach for intraprocedural image guidance during prostatic artery embolization, that generates additional information and safety, compared to MRA and DSA alone.

Printed on: 10/29/20

VSPD11

Pediatric Series: Pediatric Neuroradiology

Sunday, Dec. 1 10:45AM - 12:15PM Room: E451B

NR PD

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
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Tina Y. Poussaint, MD, Boston, MA (*Moderator*) Nothing to Disclose

Sub-Events

VSPD11-01 Pediatric Autoimmune Encephalitis

Sunday, Dec. 1 10:45AM - 11:05AM Room: E451B

Participants
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LEARNING OBJECTIVES

1) Understand concepts of Autoimmune Encephalitis, focusing on those which occur more commonly in children. 2) Understand imaging features of autoimmune encephalitis and apply MRI in the management of children suspected to have autoimmune encephalitis.

ABSTRACT

Autoimmune encephalitis is being increasingly recognized with varied causes and heterogenous symptomatology, with anti-NMDA receptor encephalitis being the most common in children. Since initial descriptions, it is now recognized that the frequency of anti-NMDA receptor encephalitis surpasses that of any viral encephalitis (California Encephalitis Project). In a multicenter study in UK, it was found that anti-NMDA receptor encephalitis was the second leading cause after acute disseminated encephalitis. Autoimmune encephalitis can be caused by antibodies to cell surface antigens (e.g. anti-NMDA receptor subunits) or to intracellular antigens (e.g. anti-Hu, Anti-Yo, anti-Ma2). In this presentation, we will also review other less common etiologies of autoimmune encephalitis, such as limbic encephalitis (including paraneoplastic). Recognition of these diseases is important as some of these disorders are highly responsive to immunotherapy, for example in anti-NMDA receptor encephalitis, 80% of patients have substantial or full recovery. References: 1) Armangue T, Petit-Pedrol M, Dalmau J. Autoimmune encephalitis in children. J Child Neurol. 2012 Nov;27(11):1460-9 2) Kelley BP, Patel SC, Marin HL, et al. Autoimmune Encephalitis: Pathophysiology and Imaging Review of an Overlooked Diagnosis. AJNR Am J Neuroradiol. 2017 Jun;38(6):1070-1078

VSPD11-02 Locations, Associations and Temporal Evolution of Intracranial Arterial Infundibular Dilatations in Children

Sunday, Dec. 1 11:05AM - 11:15AM Room: E451B

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PURPOSE

There is little data in the literature on the characteristics and natural history of intracranial arterial infundibular dilatations (IDs) in children.

METHOD AND MATERIALS

An IRB-approved retrospective review was performed, of IDs reported on MR angiography in patients <18 years of age, from 1998-2016. Clinical (age, sex, diagnosis, other vascular variants/pathology) data was recorded and images were assessed for vessel of

origin, infundibulum size and exact location. Ratios of the ID:parent artery were assessed at diagnosis and at last follow-up. Interval evolution to aneurysm was evaluated.

RESULTS

We found 63 intracranial IDs in 60 children (M:F=27:33; mean age 9.6±5.1 years, range 2-18 years). Family history of aneurysms was present in 2/60 (3.3%), while syndromic association was found in 14/60 (23.3%), most frequently Sickle Cell Disease (4/14=28.6%). Mean size of IDs was 2.2±0.5 mm, with mean ratio to parent artery of 0.5±0.2. The most common location was on the P1-PCA (34/63=53.9%), whereas posterior communicating IDs were seen in only 4/63 (6.3%) cases. Other cerebrovascular variants were seen in 12/60 (20%) patients. Follow-up imaging was performed in 32/60 (53.3%) patients - the change in ID:parent artery ratio being -0.01 over 86 patient-years. Interval evolution to aneurysm was seen in 1/63 (1.6%), occurring in an ophthalmic ID.

CONCLUSION

Pediatric intracranial arterial IDs are distinct from their adult counterparts with regard to location, etiology and temporal evolution. Growth over time or aneurysmal formation is very unusual, not necessitating frequent short-term imaging surveillance during childhood.

CLINICAL RELEVANCE/APPLICATION

To our knowledge, this is the only large study to demonstrate the temporal evolution of infundibular dilatation to aneurysm with follow-up implications over childhood.

VSPD11-03 Decrease of White Matter Integrity in Obese Adolescents: Study of Diffusion Tensor Imaging (DTI)

Sunday, Dec. 1 11:15AM - 11:25AM Room: E451B

Participants
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PURPOSE

The aim of this study is to investigate the influence of childhood obesity on changes in brain connectivity, comparing to lean adolescents, using DTI by Magnetic Resonance (MRI).

METHOD AND MATERIALS

The images were obtained on 3T MRI scanner. The sample consisted of 120 subjects: 59 obese adolescents and 61 healthy adolescents, aged 12 years to 16 years, and matched regarding gender, age, sexual development and schooling.The images were processed with the FSL-Tbss (Tract Based Spatial Statistics) program and analyzed statistically by the programMATLAB-SPM8 (Statistical Parametric Mapping) with T-test (obese group versus control group). The DTI-measure used was the Fractonal Anisotropy (FA). In this study, the significant statistical level considered was 95% or $p < 0.05$. Blood tests were done to evaluate inflammatory markers ratios in order to elucidate the systemic inflammation associated with the obesity. Then, correlation maps with inflammatory markers (TNF-a, TNF-ß, IL1-a, IL1-ß, IL6). was performed to evaluate the influence of inflammation on cerebral changes.

RESULTS

The statistical and exploratory analysis of 339350 voxels showed a reduction of the FA values in obese patients when compared to the control group in regions located in the body of the corpus callosum (pfwe <0.001), splenius of the corpus callosum (pfwe <0.017) and medium orbital gyrus (pfwe <0.044). There was no region with increased FA in obese patients. Correlation maps revealed a negative association with TNF-ß and FA values in splenium of Corpus Callosum (pfwe = 0.028; z = 3.66; cluster = 10 voxels). IL6 also presents negative correlation with FA values in medial orbital gyrus (pfwe = 0.028; z = 3.58; cluster = 10 voxels) and body of Corpus Callosum (pfwe = 0.05; z = 3.29; cluster = 5 voxels). There were no positive correlation results with inflammatory markers and FA values.

CONCLUSION

The data reveal a pattern of damage in important regions responsable for control of appetite, emotions and cognitive functions in obese adolescents, and correlation with some inflammatory markers.Further studies need to be performed to elucidate whether, in fact, obesity infammation is a consequence of structural changes in the brain.

CLINICAL RELEVANCE/APPLICATION

Childhood obesity is a subject of high clinical importance, and presents data of ascent from 10 to 40% of the last 10 years in most countries.

VSPD11-04 Diagnostic Performance of DTI Network for Detection of Spastic Cerebral Palsy Due to Periventricular White Matter Injury

Sunday, Dec. 1 11:25AM - 11:35AM Room: E451B

Participants
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PURPOSE

To determine the brain network responsible for motor dysfuction, and evaluate the diagnostic performance of diffusion tensor imaging (DTI) network for detection of periventricular white matter injury (PWMI) with spastic cerebral palsy (SCP).

METHOD AND MATERIALS

A total of 72 infants with the age 6-18months were included in our study and divided into PWMI with SCP group (n=20), non-CP PWMI group (n=19),and control group (n=33). In this study, 3D-MPRAGE T1WIs, FSE-T2WIs and DTI were performed in a 3T scanner (GE, Signa HDxt) with 8-channel head coil.The process of DTI data mainly included extracting brain images, correcting eddy current, calculating the DTI metrics, defining network nodes and edges, constructing networks using deterministic tractography. GRETNA software was used to generate FN-weighted brain network parameters. The intergroup differences in node efficiency were analyzed via analysis of covariance, where gestational age, birth weight and age upon MRI examination were taken as the covariates. After that, the intergroup comparison was corrected by Bonferroni method. Receiver operating characteristic (ROC) curve was employed to assess the diagnostic accuracy of PWMI with SCP. Differences with P values <0.05 were considered to be statistically significant.

RESULTS

Compared with the control group, the node efficiency in the PWMI with SCP group was extensively reduced (P<0.05); the node efficiency within the posterior part of the brain in the non-CP PWMI group was decreased as well (P<0.05), while the node efficiency of multiple brain regions in the frontal part (prefrontal cortex and striatum) was enhanced (P<0.05). Furthermore, compared with the non-CP PWMI group, the node efficiency of sensorimotor network, including bilateral precentral and postcentral gyrus and supplementary motor area, was reduced in the PWMI with SCP group (Figure A). Using logistic regression analysis model, the node efficiency of sensorimotor network exhibited high sensitivity (95%) and specificity (94.74%) for differentiating PWMI with SCP and those without CP(Area under the curve=0.97) (Figure B).

CONCLUSION

The sensorimotor network damage plays an important role in motor dysfuction in PWMI infants. The node efficiency can be regarded as a sensitivity indicator for the diagnosis of PWMI with SCP.

CLINICAL RELEVANCE/APPLICATION

Early diagnosis of PWMI with SCP can guide early intervention and therapy.

VSPD11-05 Evaluation of Neuroinflammation in Children with Infantile Spasms Using C-11-PK11195 Brain PET Before and After Adrenocorticotropic Hormone Treatment and mRNA Expression in Surgical Brain Tissue

Sunday, Dec. 1 11:35AM - 11:45AM Room: E451B

Participants
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PURPOSE

We investigated the presence of neuroinflammation in Infantile Spasms (IS) children using pre- and post-ACTH (Adrenocorticotropic Hormone) treatment C-11-PK11195 Brain PET (PK PET), which measures translocator protein (TSPO), upregulated due to microglial activation in neuroinflammation, and by measuring brain tissue mRNA expression, obtained from IS children undergoing epilepsy surgery.

METHOD AND MATERIALS

Eight IS children underwent dynamic PK PET before and after ACTH treatment. Both visual and quantitative analyses of the PK PET were performed by calculating regional binding potentials (BP: measure of TSPO-PK binding) using a reference tissue model. The PK BP values in IS group were compared with a control PK data created from 10 children with focal epilepsy, normal MRI and no focal increases on PK PET. We obtained gene expression data from brain tissue samples of 14 children with current or history of IS who underwent epilepsy surgery (age: 11-63 months). Children with active IS (n=5) were compared to children with focal epilepsy and history of IS, at the time of surgery (n=9).

RESULTS

Focal areas of increased PK binding were seen in the cortical and subcortical brain regions, prior to ACTH treatment, in 5 children. After ACTH treatment, PK binding was either reduced or normalized with cessation (n=4) or significant reduction (n=1) of spasms and complete disappearance of hypsarrythmia (EEG pattern seen in IS) in all children (Table & Figure). TSPO mRNA expression and

several neuroinflammatory pathways such as TOLL and NOD-like receptor signaling, antigen processing/presentation, complement and coagulation cascade and phagosome pathways were upregulated in brain tissue resected from children with current IS compared to those with focal epilepsy at the time of surgery. Conversely, the terpenoid backbone synthesis pathway, critical for neurosteroid synthesis, was downregulated.

CONCLUSION

PK PET demonstrated elevated TSPO binding, suggesting neuroinflammation, in IS children which decreased following ACTH treatment. Gene expression data demonstrated differential inflammatory pathway activation in children with current IS compared to those with focal epilepsy at the time of surgery, suggesting potential therapeutic targets.

CLINICAL RELEVANCE/APPLICATION

This study contributes to in vivo understanding of the etiopathogenesis of infantile spasms, effect of treatment and identification of potential molecular therapeutic targets.

VSPD11-06 Radiomics Improved MRI Characterizations and Differentiation of Neonatal Acute Bilirubin Encephalopathy from Normal Myelination

Sunday, Dec. 1 11:45AM - 11:55AM Room: E451B

Participants
Liya Wang, MD, Shenzhen, China (*Presenter*) Nothing to Disclose
Zhou Liu, MD, Shenzhen, China (*Abstract Co-Author*) Nothing to Disclose
Bing Ji, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Ge Cui, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Yuzhong Zhang, MD,PhD, Shenzhen, China (*Abstract Co-Author*) Nothing to Disclose
Hui Mao, PhD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

2718377613@qq.com

PURPOSE

Neonatal acute bilirubin encephalopathy (ABE) presents commonly with hyperintense globus pallidus in T1-weighted spin echo MRI (T1WI). However, normal myelination of newborns may cause similar contrast singal change (Figure A), leading to ambiguity in the diagnosis of ABE. We examined whether radiomics features derived from T1WI can be applied to better characterize and distinguish ABE from normal myelination.

METHOD AND MATERIALS

29 neonates with normal myelination and 32 neonates with clinically confirmed ABE were enrolled in this retrospective study. In addition to a radiologist-defined features, relative mean intensity, radiomics features were extracted from the globus pallidus manually segmented in T1WI. Two sample T-test, least absolute shrinkage and selection operator (LASSO) regression and Pearson's correlation were subsequently used to remove irrelevant and redundant features. A prediction model for ABE was built based on multiple machine learning classification algorithms and selected discriminative features. Using a leave-one-out cross-validation scheme splitting data into training set and validation set, the prediction performance was evaluated with the value of area under curve (AUC) calculated based on the receiver operating characteristics (ROC) curve.

RESULTS

Among all 1319 radiomics features, relative mean intensity and 12 texture features were selected as the most discriminative features. Decision trees classifier had the best performance in distinguishing ABE from normal myelination with an AUC of 0.946 (Figure B, C). Among 13 features, relative mean intensity which reflects the overall brightness of globus pallidus was the most discriminative feature based on the Fisher score (Figure D). However, its histogram showed significant overlap between ABE and normal myelination (Figure E).

CONCLUSION

The addition of radiomics features enables not only revealing subtle morphological heterogeneity induced by ABE, but also quantifying the contrast change, both of which are difficult in the conventional visual-based radiological reading strategy. Thus, this approach is feasible to improve characterization and differentiation of these two conditions.

CLINICAL RELEVANCE/APPLICATION

Radiomics features improved characterization of overlapped contrast changes in T1WI induced by ABE and normal myelination, which can be used to assist differentiation of these two different conditions.

VSPD11-07 Congenital CNS Infections

Sunday, Dec. 1 11:55AM - 12:15PM Room: E451B

Participants
Jason N. Wright, MD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List the commonest imaging findings in congenital CNS infections. 2) Construct a relevant differential diagnosis for congenital CNS infections, based on imaging phenotype.

ABSTRACT

Congenital CNS infections can be a difficult and confusing topic for neuroimagers, due to their often overlapping and nonspecific clinical characteristics, as well as the numerous and protean imaging features that may associated. It is not possible to confidently identify the existence or specific type of congenital CNS infection in every instance. However, careful attention to the imaging phenotype can allow the construction of a relevant and concise differential diagnosis, directing clinical attention to the most likely

infectious etiology or possible mimic. The recent epidemic of congenital Zika virus infection has drawn new light to this topic, and highlights the need for attention to new and evolving pathogens worldwide.

Printed on: 10/29/20

RCA11

Hands-on Introduction to Social Media (Hands-on)

Sunday, Dec. 1 11:00AM - 12:30PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Amy K. Patel, MD, Liberty, MO (*Moderator*) Nothing to Disclose
Amy K. Patel, MD, Liberty, MO (*Presenter*) Nothing to Disclose
Saad Ranginwala, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Tirath Y. Patel, MD, Perrysburg, OH (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

amykpatel64112@gmail.com

LEARNING OBJECTIVES

1) Appreciate the professional relevance of social media for radiologists. 2) Understand the differences between social media in personal and professional roles. 3) Understand the differences between and advantages/disadvantages of multiple social media networks. 4) Devise and utilize a Twitter account.

Printed on: 10/29/20

RCC11

CT Protocol Management Across a Healthcare System

Sunday, Dec. 1 11:00AM - 12:30PM Room: S406B

CT IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Kevin Little, PhD, Columbus, OH (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the importance of CT protocol management to an imaging practice. 2) Identify tools that can be used to develop consistent protocols across multiple systems. 3) Develop awareness of the Management of Acquisition Profiles (MAP) IHE profile and features that should be requested from CT scanner vendors.

ABSTRACT

CT protocols, which include all clinical and technical parameters for a given study, are the starting point for achieving high-quality images with reasonable radiation and contrast doses. An imaging practice that desires to follow the ALARA principle and produce high-quality images should have standardized protocols across their enterprise. Accreditation standards require a periodic review of all scanner protocols. However, variations among vendors, models, and clinical indications mean that managing and optimizing dozens of parameters for each protocol on every scanner in a health system is challenging. Even when variations between systems are limited, managing protocol names and parameters across multiple systems can be difficult. The purpose of this symposium is to identify tools and techniques that may be used to manage protocols across multiple systems and to provide a framework for protocol optimization.

Sub-Events

RCC11A Overview of CT Protocol Parameters and Protocol Management Pitfalls

Participants
Kevin Little, PhD, Columbus, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize the practical and regulatory requirements for protocol management. 2) Identify the technical and clinical parameters that may be included as part of a CT protocol. 3) Understand common difficulties in managing protocols across system vendors, models, and geographic locations.

RCC11B Available Methods, Strategies, and Tools for CT Protocol Management

Participants
Timothy P. Szczykutowicz, PhD, Madison, WI (*Presenter*) Equipment support, General Electric Company; License agreement, General Electric Company; Founder, Protocolshare.org LLC; Medical Advisory Board, medInt Holdings, LLC; Consultant, General Electric Company; Consultant, Takeda Pharmaceutical Company Limited

For information about this presentation, contact:

tszczykutowicz@uwhealth.org

LEARNING OBJECTIVES

1) Apply the master protocol concept to your acquisition parameters over your CT fleet. 2) Apply the master protocol concept to your reconstruction parameters over your CT fleet. 3) Gain an understanding of current commercial and custom solutions for protocol management.

ABSTRACT

The talk will detail a CT protocol management strategy called the master protocol concept. The concept groups together phases of indication requiring similiar: levels of image quality, body regions, scan times, and contrast enhancement. Once grouped, 'master' acquisition parameters can be defined for each master protocol. We will show how this simplifies protocol management across a diverse fleet of CT scanners. In other words, it changes a three phase abdomen CTA protocol from being thought of as composed of three unique sets of acqusition parameters into: abdomen CTA master, then 2 phases using the routine abdomen master. We will also apply the same concept to reconstruction parameters. This allows the creation, for example, of identical lung field images across any protocol imaging the chest whether it is a dedicated thoracic protocol or a gated chest CTA. Lastly, we will survey current commerical and custom solutions for protocol management. The goal of the survey will be to inform the attendee on what options exsist today to guide their selection of such a producitivity/complainace informatics solution.

Active Handout:Timothy Peter Szczykutowicz

http://abstract.rsna.org/uploads/2019/19003659/Active RCC11B.pdf

RCC11C Details and Features of DICOM Protocol Storage and the IHE Management of Acquisition Protocols (MAP) Profile

Participants
Kevin O'Donnell, Pacifica, CA (*Presenter*) Employee, Canon Medical Systems Corporation

Printed on: 10/29/20

SPAI12

RSNA AI Deep Learning Lab: Segmentation

Sunday, Dec. 1 1:00PM - 2:30PM Room: AI Showcase, North Building, Level 2, Booth 10342

AI CT MR NR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants

George L. Shih, MD, New York, NY (*Presenter*) Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;

Special Information

In order to get the best experience for this session, it is highly recommended that attendees bring a laptop with a keyboard, a decent-sized screen, and the latest version of Google Chrome. Additionally, it is recommended that attendees have a basic knowledge of deep learning programming and some experience running a Google CoLab notebook. Having a Gmail account is also helpful. Here are instructions for creating and deleting a Gmail account.

ABSTRACT

This session will focus on the use of deep learning methods for image segmentation, applied to the challenge of CT or MR brain segmentation. While focused on this particular problem, the concepts should generalize to other organs and image types.

Printed on: 10/29/20

VSIO11

Interventional Oncology Series: Interventional Therapies for Primary and Metastatic Lung Tumors

Sunday, Dec. 1 1:00PM - 3:00PM Room: S405AB

CH IR OI RO

AMA PRA Category 1 Credits ™: 2.00
ARRT Category A+ Credits: 2.25

Participants
Florian J. Fintelmann, MD, Boston, MA (*Moderator*) Consultant, Jounce Therapeutics, Inc; Research support, BTG International Ltd
Afshin Gangi, MD,PhD, Strasbourg, France (*Moderator*) Consultant, AprioMed AB

For information about this presentation, contact:

fintelmann@mgh.harvard.edu

LEARNING OBJECTIVES

1) Review recent advances pertaining to microwave and cryoablation in the thorax. 2) Discuss data supporting thermal ablation of lung cancer and thoracic metastases. 3) Learn how to integrate thermal ablation into the interdisciplinary management of thoracic neoplasms.

Sub-Events

VSIO11-01 The Role of RFA for Lung Ablation in the Era of Microwave

Sunday, Dec. 1 1:00PM - 1:15PM Room: S405AB

Participants
Jean Palussiere, MD, Bordeaux, France (*Presenter*) Speaker, Boston Scientific Corporation

LEARNING OBJECTIVES

1) To develop specificities of lung tissue following heating. 2) To specify technical differences between Radiofrequency ablation and microwave ablation applied to lung tumors. 3) To define the best indications for each technique. 4) To list the limits, indications and contraindications for each technique. 5) To identify whether some development are awaited and might increase indications.

VSIO11-02 Thoracic Cryoablation

Sunday, Dec. 1 1:15PM - 1:30PM Room: S405AB

Participants
William H. Moore, MD, Port Washington, NY (*Presenter*) Consultant, Merck & Co, Inc Consultant, BTG International Ltd

LEARNING OBJECTIVES

1) Highlight the results of Cryoablation and the potential role for ablation in primary lung cancer and metastatic diseases. 2) Identify the Strength of Cryoablation in the lung. 3) Compare Ablative Technique in the Lung.

VSIO11-03 Transarterial Chemoperfusion (TACP) And Transpulmonary Chemoembolization (TPCE) for the Treatment of Lung Metastases: Palliative Treatment Approach

Sunday, Dec. 1 1:30PM - 1:40PM Room: S405AB

Participants
Thomas J. Vogl, MD, PhD, Frankfurt , Germany (*Presenter*) Nothing to Disclose
Ahmed I. Ahmed, MBCHB, Assiut, Egypt (*Abstract Co-Author*) Nothing to Disclose
Duaa B. Thabet, Assiut, Egypt (*Abstract Co-Author*) Nothing to Disclose
Mostafa A. El-Sharkaway, Assiut, Egypt (*Abstract Co-Author*) Nothing to Disclose
Hossam M. Kamel, Assiut, Egypt (*Abstract Co-Author*) Nothing to Disclose
Nour-eldin A. Nour-Eldin, MD,PhD, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose
Nagy N. Naguib, MD, MSc, Frankurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Afaf A. Hassan, Assiut, Egypt (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

T.Vogl@em.uni-frankfurt.de

PURPOSE

To evaluate tumor response, local tumor control and patient survival after the treatment of secondary lung malignancies using transpulmonary chemoemboilzation (TPCE) and transarterial chemoperfusion (TACP) in a palliative indication.

METHOD AND MATERIALS

±In this retrospective study 161 patients (mean 55.3±13.8 years; 82 females/79 males) who had failied previous systemic chemotherapy were treated with either repetitive TPCE (n=92) or TACP (n=69) between August 2004 and April 2017 for

unresectable pulmonary metastases. The median number of sessions was 5 per patient, the median number of nodules 16 and bilateral lung involvement 85.1%. The chemotherapeutic agents used were Mitomycin C, Cisplatin, Gemcitabine and/or Irinotecan. Nine patients received other combinations according to their physicians' recommendations. Either the tumor-supplying pulmonary arteries were catheterized followed by injection of the chemotherapeutic agents, iodized oil and microspheres (TPCE group) or the chemotherapy was non-selectively injected intra-arterielly opposite the orifices of the main tumor-supplying arteries (TACP group). The response was assessed using the revised RECIST criteria.

RESULTS

After evaluation of the tumor response partial response (PR) was achieved in 8.7% (n=14), stable disease (SD) in 65.2% (n=105) and progressive disease (PD) in 26.1% (n=42). The estimated mean survival time and time to progression were 19.7±2 and 7.1±0.7 for the TPCE group and 15.6±1.6 and 6.5±0.6 for the TACP group, respectively. Patients who underwent TPCE had a non significantly longer mean survival time than the TACP group. Patients with PR and SD had a significantly ($p<0.05$) better survival (mean: 25±4.4 and 19±1.8 months, respectively) than those with PD (mean 14±2.3 months).

CONCLUSION

Both TPCE and TACP are feasible treatment options for patients with secondary lung malignancies with acceptable local control and survival rates. A more favorable initial response to the locoregionally delivered chemotherapy might be a positive predictor for survival.

CLINICAL RELEVANCE/APPLICATION

TACP and TPCE improve local tumor control and prolong survival in patients with pulmonary metastases

VSIO11-04 Ablation versus Radiation versus Surgery for Lung Cancer

Sunday, Dec. 1 1:40PM - 1:55PM Room: S405AB

Participants
Stephen B. Solomon, MD, New York, NY (*Presenter*) Consultant, BTG International Ltd ; Consultant, Johnson & Johnson; Consultant, XACT Robotics; Consultant, Endoways; Consultant, Aperture Medical Technology; Researcher, General Electric Company; Researcher, Johnson & Johnson; Researcher, AngioDynamics, Inc; Stockholder, Aspire Bariatrics; Stockholder, Johnson & Johnson; Stockholder, Immunomedics, Inc; Stockholder, Strongbridge; Stockholder, Progenics Pharmaceuticals, Inc; Stockholder, Aperture Medical Technology; Stockholder, Innoblative; Stockholder, Surefire Medical, Inc

LEARNING OBJECTIVES

1) Understand the difference in treatment options for lung cancer.

VSIO11-05 Ablation versus Radiation versus Surgery for Lung Metastases

Sunday, Dec. 1 1:55PM - 2:10PM Room: S405AB

Participants
Ashok Muniappan, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the surgical technique of pulmonary metastasectomy. 2) Compare efficacy and utility of surgical metastasectomy to that of ablation and radiation. 3) Discuss the strategy of combining surgical metastasectomy and ablation to manage pulmonary metastases.

VSIO11-06 Effectiveness of Local Therapy for the Treatment of Lung Carcinoid Tumors

Sunday, Dec. 1 2:10PM - 2:20PM Room: S405AB

Participants
Meaghan Dendy Case, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Johannes Uhlig, Goettingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Hyun S. Kim, MD, New Haven, CT (*Abstract Co-Author*) Boston Scientific Corporation; Galil Medical Ltd ; Sirtex Medical Ltd

PURPOSE

To determine the potential benefit of local and systemic therapy in lung carcinoid tumors.

METHOD AND MATERIALS

Data from lung carcinoid patients receiving surgical resection, external beam radiation therapy, thermal ablation or systemic therapy alone was acquired from the 2004-2015 National Cancer Database (NCDB). Patient and tumor characteristics across different treatment strategies were compared using univariate Wilcoxon test. Overall survival (OS) was evaluated via multivariable Cox proportional hazards models. Comparison was made between SBRT, thermal ablation, surgical resection and compared with systemic therapy alone.

RESULTS

34,205 patients from the NCDB database fulfilled inclusion criteria (SBRT n = 5,489; surgery n= 9,025; TA n = 67; systemic therapy alone n = 19,624.) Treatments differed across patient demographics and disease characteristics, with higher likelihood of TA in older male Caucasians with high comorbidities, and late-stage disease with small diameter. Prior to multivariable adjustment, SBRT, surgical resection, and thermal ablation all demonstrated superior OS compared to systemic therapy alone (compared to systemic therapy alone: SBRT HR = 0.56, 95% CI: 0.54-0.58, $p < 0.001$; surgical resection HR = 0.19, 95% CI: 0.18-0.20, $p < 0.001$; TA HR = 0.58, 95% CI: 0.44-0.76, $p < 0.001$). SBRT and surgical resection treatment demonstrated superior survival compared to systemic therapy alone after multivariable adjustment (SBRT HR = 0.74, 95% CI: 0.70-0.77, $p < 0.001$; surgical resection HR = 0.39, 95% CI: 0.37-0.41). Additional independent predictors of survival (p-values of <0.05) were patients with one or more comorbidities, male gender, Caucasian race, age, low cancer stage and grade, small tumor diameter, and type of treatment facility.

CONCLUSION

Patients with lung carcinoid tumor who received SBRT, surgical resection or TA demonstrated prolonged survival when compared to those patients who received systemic therapy only. The limited number of patients receiving TA limits the ability to determine survival significance after multivariable analysis, and more research in this area is required to determine its utility in prolonging survival in these patients.

CLINICAL RELEVANCE/APPLICATION

Locoregional therapies demonstrate increased survival benefits when used in patients with carcinoid lung tumors. TA and SBRT demonstrate similar effectiveness in prolonging overall survival in patients with carcinoid lung cancer.

VSIO11-07 Ablation and Immune Modulation

Sunday, Dec. 1 2:20PM - 2:35PM Room: S405AB

Participants
Joseph P. Erinjeri, MD,PhD, New York, NY (*Presenter*) Advisory Board, AstraZeneca PLC; Advisory Board, BTG International Ltd; Consultant, Jounce Therapeutics, Inc; Consultant, Canon Medical Systems Corporation

VSIO11-08 Starting and Developing a Lung Ablation Program

Sunday, Dec. 1 2:35PM - 2:50PM Room: S405AB

Participants
Florian J. Fintelmann, MD, Boston, MA (*Presenter*) Consultant, Jounce Therapeutics, Inc; Research support, BTG International Ltd

For information about this presentation, contact:

fintelmann@mgh.harvard.edu

LEARNING OBJECTIVES

1) Discuss strategies to start and grow a lung ablation program at your institution. 2) Outline a path to move from lung biopsy and fiducial placement to thermal ablation. 3) Discuss the role of interdisciplinary collaboration, case selection and patient management.

VSIO11-09 Panel Discussion

Sunday, Dec. 1 2:50PM - 3:00PM Room: S405AB

RC101

Lung Cancer Screening (Interactive Session)

Sunday, Dec. 1 2:00PM - 3:30PM Room: S402AB

CH CT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Caroline Chiles, MD, Winston-Salem, NC (*Moderator*) Nothing to Disclose

Special Information

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

LEARNING OBJECTIVES

1) Confirm compliance with screening guidelines, including patient eligibility, scanning protocols, radiation dose, CMS requirements and National Lung Screening Registry. 2) Incorporate shared decision making and smoking cessation in the lung screening visit. 3) Assign Lung-RADS categories to nodules encountered at baseline and annual screening CT. 4) Evaluate atypical screening findings. 5) Manage incidental findings, including COPD, coronary artery calcification, and potential extrapulmonary malignancies.

Sub-Events

RC101A Logistics of Screening

Participants
Jared D. Christensen, MD, Durham, NC (*Presenter*) Advisory Board, Riverain Technologies, LLC

LEARNING OBJECTIVES

1) Confirm compliance with screening guidelines, including patient eligibility, scanning protocols, radiation dose, CMS requirements, and National Lung Screening Registry.

RC101B Feasible Approaches to Shared Decision-making for Lung Cancer Screening

Participants
Robert Volk, PhD, Houston, TX (*Presenter*) Nothing to Disclose

RC101C Nodule Assessment and Lung-RADS™ Categories

Participants
Mylene T. Truong, MD, Houston, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review Lung-RADS categories and nodule management strategies. 2) To review how patient risk can impact nodule management.

RC101D Interesting Cases Encountered in a Screening Program

Participants
Brett M. Elicker, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the role of imaging in the multi-disciplinary approach to suspected lung cancer. 2) Compare the different management options in suspected lung nodules detected on lung cancer screening CT. 3) Summarize how to appropriately use Lung-RADS when interpreting lung cancer screening CTs.

RC101E Incidental Findings on the Low-Dose CT

Participants
Carol C. Wu, MD, Houston, TX (*Presenter*) Author, Reed Elsevier

LEARNING OBJECTIVES

1) Describe the prevalence and significance of incidental findings on LDCT. 2) Apply the latest evidence-based management recommendations for various incidental findings on LDCT.

RC102

Maximizing Our Learning Potential: How Can We Learn Best?

Sunday, Dec. 1 2:00PM - 3:30PM Room: S105AB

ED

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Aaron P. Kamer, MD, Indianapolis, IN (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Use zany, brainy, and cockamamie adult-education theories and techniques to bolster our own learning and the education of our trainees.

Sub-Events

RC102A Expanding the Circle: Building on What We Know

Participants
Aaron P. Kamer, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the value of teaching concepts that relate to a learner's current knowledge. 2) Establish a one-on-one teaching style that provides an optimal level of challenge for the radiology learner. 3) Provide scaffolding at an appropriate level to maximize learning for radiology trainees.

RC102B Video-based Learning: Effectiveness of a Hybrid Model

Participants
Nelly Tan, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Compare hybrid learning to traditional learning models. 2) Review literature on effectiveness of hybrid learning. 3) Case examples of hybrid learning for radiology for medical education.

RC102C Gamification and Question Asking: Utility of Mistakes in Learning

Participants
Victor F. Sai, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

vsai@mednet.ucla.edu

LEARNING OBJECTIVES

1) Examine learning methods and how to maximize learning efficiency through active learner participation/gaming and learning through mistakes.

RC102D Micro-habits for Deep Learning: Optimizing Your Daily Practice for Life-long Learning

Participants
Aarti Sekhar, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

aarti.sekhar@gmail.com

LEARNING OBJECTIVES

1) Become familiar with the concept of 'micro-habits' and how to embed new healthy habits with already existing habits. 2) Explore radiology micro-habits that propagate continuous learning, such as: mini-case conferences during the workday; constructing meaningful didactics; tumor boards; case logs with pathology follow-up; and virtual 'embedding' to facilitate clinical services and encourage multi-disciplinary exchange. 3) Briefly explore non-radiology micro-habits that can augment learning including sleep hygiene and exercise. 4) Consider how micro-habits can lead to decreased burn-out and sustainable life-long learning.

RC103

Read with the Experts (Cardiac Radiology) (Interactive Session)

Sunday, Dec. 1 2:00PM - 3:30PM Room: N230B

CA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

FDA Discussions may include off-label uses.

Participants
Jill E. Jacobs, MD, New York, NY (*Moderator*) Nothing to Disclose
Cylen Javidan, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Smita Patel, FRCR,MBBS, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Sanjeev Bhalla, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Amar B. Shah, MD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ashah27@northwell.edu

LEARNING OBJECTIVES

1) Use cardiac CTA cases to allow participants to generate an appropriate differential diagnosis using Cardiac CTA and Cardiac MRI when reviewing cases. 2) Develop a better understanding of when Cardiac CTA and Cardiac MRI can be used for diagnosis.

RC104

Advanced Muscle Imaging: State of the Art

Sunday, Dec. 1 2:00PM - 3:30PM Room: E450A

MR MK

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Robert D. Boutin, MD, Davis, CA (*Director*) Nothing to Disclose

LEARNING OBJECTIVES

1) Assess state-of-the-art imaging techniques for diagnosis of acute and chronic muscle derangements, with an emphasis on MRI, CT, and sonography.

Sub-Events

RC104A Acute Muscle Injuries: MRI Protocol, Classification, and Prognosis

Participants
James M. Linklater, MBBS, St Leonards , Australia (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

JamesLinklater@casimaging.com

LEARNING OBJECTIVES

1) Define the musculo-tendinous anatomy of the hamstring, quadriceps, adductor and gastrocnemius-soleus muscle groups. 2) Define efficient, sensitive MRI protocols to assess for acute muscle injuries in the lower extremities. 3) Identify on imaging and classify patterns of injury to the hamstring, quadriceps, adductor and gastrocnemius-soleus muscle groups. 4) Understand classification and grading systems used in the evaluation of acute muscle injuries in the lower extremities and their potential value in determining prognosis regarding return to sport.

Active Handout:James MacPherson Linklater

http://abstract.rsna.org/uploads/2019/19000728/Active RC104A.pdf

RC104B Chronic Muscle Conditions: A Practical Approach

Participants
Robert D. Boutin, MD, Davis, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review chronic muscle derangements and apply knowledge using a case-based approach, with an emphasis on practical differential diagnostic patterns.

RC104C MRI versus Ultrasound of Muscle: Choosing When and How

Participants
Kambiz Motamedi, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kmotamedi@mednet.ucla.edu

LEARNING OBJECTIVES

1) Identify the appropriate diagnostic imaging modality for common muscle pathologies. 2) Describe normal and abnormal ultrasound appearance of muscle. 3) Compare imaging characteristics of muscle pathology on MRI versus ultrasound.

Active Handout:Kambiz Motamedi

http://abstract.rsna.org/uploads/2019/19000731/Active RC104C.pdf

Active Handout:Kambiz Motamedi

http://abstract.rsna.org/uploads/2019/19000731/Active RC104C.pdf

RC104D Muscle Ischemia, Infarction, and Compartment Syndrome

Participants
Michael D. Ringler, MD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize imaging findings associated with common clinical syndromes involving muscle ischemia, including compartment

1) Recognize imaging findings associated with common clinical syndromes involving muscle ischemia, including compartment syndrome. 2) Differentiate appearance of irreversible myonecrosis from treatable ischemia. 3) Design an MR protocol for Chronic Exertional Compartment Syndrome.

RC104E Imaging of Muscle Quality: Myosteatosis Revisited

Participants
Leon Lenchik, MD, Winston-salem, NC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

llenchik@wakehealth.edu

LEARNING OBJECTIVES

1) Discuss the imaging diagnosis of myosteatosis and its relation to muscle quality.

Printed on: 10/29/20

RC105

Practical and Advanced Spine Imaging

Sunday, Dec. 1 2:00PM - 3:30PM Room: N229

NR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Wende N. Gibbs, MD, Scottsdale, AZ (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

WendeNGibbs@gmail.com

Sub-Events

RC105A Advanced Imaging of the Lumbosacral Plexus and Lower Extremity Peripheral Nerves

Participants
Vinil Shah, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe advanced imaging techniques of the spinal cord and peripheral nerves that can be implemented in daily clinical practice, with a particular emphasis on diffusion tensor imaging (DTI). 2) Understand how DTI can play an important problem-solving role in patients with spinal cord pathology and peripheral nerve diseases. 3) Describe the practical value of DTI in preoperative planning, differentiating benign from malignant entities, assessing severity of nerve injury, and monitoring early nerve regeneration.

RC105B Practical Neurography: The Brachial Plexus

Participants
Carlos H. Torres, MD,FRCPC, Ottawa, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

catorres@toh.ca

LEARNING OBJECTIVES

1) Simplify the complex imaging anatomy of the brachial plexus. 2) Outline different MR protocols to image the brachial plexus including conventional and advanced imaging techniques. 3) Review brachial plexus pathologies, using a case-based approach.

ABSTRACT

Magnetic Resonance Imaging (MRI) is the imaging modality of choice for the evaluation of the brachial plexus due to its superior soft tissue resolution and multiplanar capabilities. The evaluation of the brachial plexus however represents a diagnostic and a clinical challenge due to the complexity of the anatomy and due to technical factors. The presentation will emphasize the different MR protocols that could be used at 1.5T and 3T in order to improve the visualization of the different segments of the brachial plexus. In addition, the normal anatomy as well as the common and infrequent pathologies involving the brachial plexus will be reviewed.

RC105C Improving Spine Imaging: Can Artificial Intelligence Help?

Participants
Lawrence N. Tanenbaum, MD, Riverside, CT (*Presenter*) Speaker, General Electric Company; Speaker, Siemens AG; Speaker, Guerbet SA; Speaker, Koninklijke Philips NV; Consultant, Enlitic, Inc; Consultant, icoMetrix NV; Consultant, Subtle Medical; Consultant, Arterys Inc

For information about this presentation, contact:

nuromri@gmail.com

LEARNING OBJECTIVES

1) To be exposed to the range of reconstruction techniques including iterative reconstruction, and deep learning and their impact on image quality. 2) To be familiarized with AI assisted diagnosis in imaging of the spine.

ABSTRACT

Improving Imaging of the Spine: Can artificial Intelligence help? Performing and interpreting MR imaging of the spine remain quite challenging despite recent advances. Application of artificial intelligence techniques based on machine learning including iterative reconstruction, and deep learning will lead to advances in image quality. AI may also improve the efficiency and potentially improve the value of imaging based diagnosis. This presentation will survey the latest techniques and assess their impact in research and clinical practice.

RC105D Imaging of the Osseous Spine: Adding Value and Optimizing Patient Care

Participants
Wende N. Gibbs, MD, Scottsdale, AZ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

WendeNGibbs@gmail.com

LEARNING OBJECTIVES

1) Discuss recent advances in surgical and radiotherapy treatment for osseous metastatic disease, and the consequent implications for imaging evaluation of cancer patients. 2) Describe the grading systems for oncology instability and spinal cord compression that should be incorporated into the radiology report in order to facilitate efficient communication and improved patient care.

Printed on: 10/29/20

RC106

Bread and Butter Sinus Imaging: Telling Your Referrers What They Need to Know

Sunday, Dec. 1 2:00PM - 3:30PM Room: E451B

HN NR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Sub-Events

RC106A Sinonasal Anatomy

Participants
Nicholas A. Koontz, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify normal paranasal sinus anatomy. 2) Distinguish the normal paranasal sinus outflow pathways and report patterns of paranasal sinus obstruction. 3) Recognize and report surgically-important paranasal sinus anatomic variants.

RC106B Acute Rhinosinusitis with Attention to Red Flags and Complications

Participants
Patricia A. Rhyner, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rhyner.patricia3@gmail.com

LEARNING OBJECTIVES

1) Review CT imaging findings for sinusitis - bacterial, non-invasive fungal, invasive fungal. 2) Emphasize symptoms that raise concern for aggressive or invasive sinus infection. 3) Review next appropriate imaging step when sinusitis is aggressive based on CT or symptoms. 4) Briefly emphasize CECT and MR findings of intracranial extension, venous complications, or cavernous sinus involvement.

ABSTRACT

Safder S et al. The Black turbinate sign: An early MR imaging finding of nasal mucormycosis. Amer J Neuroradiol 31:April 2010, 771-74 Groppo E et al. CT and MRI characteristics of acute invasive fungal sinusitis. Arch Otolaryn Head Neck Surg. 2011;137:1005-1010 Joshi VM, Sansi R. Imaging in sinonasal inflammatory disease. Neuroimaging Clin N Am 2015;25(4):549-68

RC106C Chronic Rhinosinusitis and Endoscopic Sinus Surgery

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

For information about this presentation, contact:

kmlloyd@emory.edu

LEARNING OBJECTIVES

1) Identify the varied imaging features of chronic sinusitis. 2) Describe the surgical indications, techniques, and most common postoperative imaging findings after endoscopic sinus surgery. 3) Detect potential postoperative complications of endoscopic sinus surgery.

RC106D Recognizing and Reporting Sinonasal Tumors

Participants
Christine M. Glastonbury, MBBS, San Francisco, CA (*Presenter*) Author with royalties, Reed Elsevier

For information about this presentation, contact:

christine.glastonbury@ucsf.edu

LEARNING OBJECTIVES

1) Recognize key features that suggest a lesion is a sinonasal malignancy and be aware of the important imaging mimics. 2) Learn the common patterns of sinonasal tumor dissemination. 3) Understand the most important imaging features to describe when staging a sinonasal tumor.

ABSTRACT

It is critical that on routine non-contrast sinus CT scans radiologists identify findings that suggest malignant or potentially malignant disease. Once this is recognized then additional findings can be sought so that the patient is correctly managed, biopsy can be obtained and treatment is not delayed. Even on non-contrast CT scans it is possible to evaluate for orbital and intracranial invasion and the retropharyngeal and often level 2 nodes can be commented on. There are many different sinonasal malignancies

and while there are some features which may suggest the likely pathological diagnosis, the role of the radiologist is more for recognizing malignancy, staging the tumor with CT/MR and describing features which may make surgery more hazardous or unwarranted. REFERENCES: 1. Kraus DH, Lydiatt WM, Patel SG, O'Sullivan B, Ghossein RA, Mukherji SK, Shah JP. Nasal Cavity & Paranasal SInuses. Chapter 12. AJCC Cancer Staging Manual 8th Edition. Amin MB, Edge SB, Greene FL et al Springer 2017. 2. Koeller KK. Radiologic Features of Sinonasal Tumors. Head Neck Pathol. 2016 Mar;10(1):1-12. Review.

Printed on: 10/29/20

RC107

Urolithiasis: Urologist Perspective, Recent Imaging Advances, and Relevance to Practice (Interactive Session)

Sunday, Dec. 1 2:00PM - 3:30PM Room: S103CD

GU

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Avinash R. Kambadakone, MD, Boston, MA (*Moderator*) Research Grant, General Electric Company; Research Grant, Koninklijke Philips NV

For information about this presentation, contact:

akambadakone@mgh.harvard.edu

LEARNING OBJECTIVES

1) Understand the urologist's perspective on stone disease and the value of imaging in the decision-making process. 2) Learn the imaging advances in diagnosis of urolithiasis including Dual energy CT techniques. 3) Discuss the multi-modality imaging techniques in diagnosis of stone disease including re-emergence of ultrasound. 4) Review the management updates in stone disease and its relevance to radiology practice.

Sub-Events

RC107A Urologist Perspective on Urolithiasis

Participants
Brian H. Eisner, MD, Boston, MA (*Presenter*) Advisory Board, Sonomotion

RC107B Imaging Approach for Flank Pain in the Emergency Department (Basics and What's New in ED)

Participants
Jennifer W. Uyeda, MD, Boston, MA (*Presenter*) Consultant, Allena Pharmaceuticals, Inc

LEARNING OBJECTIVES

1) List the various imaging modalities used to evaluate right flank pain. 2) Compare the various available types of imaging modalities to assess right flank pain. 3) Identify CT appearances of nephroureterolithiasis and associated complications. 4) Apply structured reporting of nephroureterolithiasis on CT.

RC107C Advances in CT and Radiation Dose

Participants
Avinash R. Kambadakone, MD, Boston, MA (*Presenter*) Research Grant, General Electric Company; Research Grant, Koninklijke Philips NV

For information about this presentation, contact:

akambadakone@mgh.harvard.edu

LEARNING OBJECTIVES

1) Describe the advances in the imaging diagnosis of urolithiasis with focus on DECT. 2) Learn about CT radiation dose concerns and apply strategies to diminish the risk.

RC107D Case Presentations

Participants
Nicole M. Hindman, MD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Nicole.Hindman@nyulangone.org

LEARNING OBJECTIVES

1) Learn the most common chemical stone compositions, risk factors for developing, ways to image and appropriate treatment for each type. 2) Learn imaging techniques for stone diagnosis, including Dual Energy Techniques. 3) Learn information Urologists need to know for diagnosis, monitoring and management of renal stones. 4) Review updated surgical and medical management of renal stones.

RC108

Imaging of Musculoskeletal Emergencies (Interactive Session)

Sunday, Dec. 1 2:00PM - 3:30PM Room: S406A

ER MK

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Manickam Kumaravel, MD, FRCR, Houston, TX (*Moderator*) Nothing to Disclose

Special Information

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

Sub-Events

RC108A Hip

Participants
Manickam Kumaravel, MD, FRCR, Houston, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

manickam.kumaravel@uth.tmc.edu

LEARNING OBJECTIVES

1) Understand in depth the normal anatomy of hip. 2) Appreciate subtle and catastrophic patterns of the hip and peri-hip causes of pain. 3) Effectively utilize CT and MRI in problem solving patients with hip and peri-hip causes of pain. 4) Comprehend the clinical implications of hip pain presentations.

ABSTRACT

The learner will be exposed to a wide gamut of patients presenting to the emergency room with hip and peri-hip causes of pain. Injuries will be elucidated with plain radiography, CT and MRI.

RC108B Wrist

Participants
Claire K. Sandstrom, MD, Seattle, WA (*Presenter*) Spouse, Advisory Board, Boston Scientific Corporation;

For information about this presentation, contact:

cks13@uw.edu

LEARNING OBJECTIVES

1) Review osseous and soft tissue emergencies of the wrist that may be encountered in the Emergency Department. 2) Describe appropriate imaging work-up of wrist emergencies.

RC108C Ankle and Foot

Participants
Adnan M. Sheikh, MD, Ottawa, ON (*Presenter*) Speaker, Siemens AG

For information about this presentation, contact:

asheikh@toh.ca

LEARNING OBJECTIVES

1) Review the imaging modalities to assess ankle and foot pathologies. 2) Understand the imaging features of common and uncommon ankle and foot injuries. 3) Develop strategies to reduce the possibility of a missed lesion on screening.

RC108D Shoulder

Participants
Jonathan A. Flug, MD, MBA, Phoenix, AZ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

flug.jonathan@mayo.edu

LEARNING OBJECTIVES

1) Detect imaging abnormalities commonly seen in the shoulder in the emergency setting. 2) Identify commonly encountered

shoulder pathology in the emergency setting. 3) Recommend appropriate follow up for various findings in the shoulder in the emergency setting.

ABSTRACT

The shoulder is a commonly injured body part presenting in the emergency setting. For many injuries, x-ray imaging is the first line in diagnosis and these studies may reflect a significant proportion of the workflow of a radiologist in a general or subspecialty practice. However, these injuries are often missed or have a delay in diagnosis. The purpose of this course is to review normal anatomy in the shoulder as well as commonly encountered pathology to improve diagnosis and provide strategies when x-ray imaging cannot sufficiently establish a diagnosis.

Printed on: 10/29/20

RC109

Abbreviated/Faster MRI Abdominal Pelvic Protocols

Sunday, Dec. 1 2:00PM - 3:30PM Room: E450B

GI MR OI

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Claude B. Sirlin, MD, San Diego, CA (*Moderator*) Research Grant, Gilead Sciences, Inc; Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Bayer AG; Research Grant, Koninklijke Philips NV; Consultant, AMRA AB; Consultant, Fulcrum; Consultant, IBM Corporation; Consultant, Exact Sciences Corporation; Consultant, Boehringer Ingelheim GmbH; Consultant, Arterys Inc; Consultant, Epigenomics; Author, Medscape, LLC; Lab service agreement, Gilead Sciences, Inc; Lab service agreement, ICON plc; Lab service agreement, Intercept Pharmaceuticals, Inc; Lab service agreement, Shire plc; Lab service agreement, Enanta; Lab service agreement, Takeda Pharmaceutical Company Limited; Lab service agreement, Alexion Pharmaceuticals, Inc; Lab service agreement, NuSirt Biopharma, Inc

Sub-Events

RC109A Hepatocellular Carcinoma Screening

Participants
Claude B. Sirlin, MD, San Diego, CA (*Presenter*) Research Grant, Gilead Sciences, Inc; Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Bayer AG; Research Grant, Koninklijke Philips NV; Consultant, AMRA AB; Consultant, Fulcrum; Consultant, IBM Corporation; Consultant, Exact Sciences Corporation; Consultant, Boehringer Ingelheim GmbH; Consultant, Arterys Inc; Consultant, Epigenomics; Author, Medscape, LLC; Lab service agreement, Gilead Sciences, Inc; Lab service agreement, ICON plc; Lab service agreement, Intercept Pharmaceuticals, Inc; Lab service agreement, Shire plc; Lab service agreement, Enanta; Lab service agreement, Takeda Pharmaceutical Company Limited; Lab service agreement, Alexion Pharmaceuticals, Inc; Lab service agreement, NuSirt Biopharma, Inc

For information about this presentation, contact:

csirlin@ucsd.edu

LEARNING OBJECTIVES

1) Explain the need for HCC screening in adults with cirrhosis. 2) Explain the limitations of ultrasound for HCC screening in adults with cirrhosis, in particular adults with overweight or obesity. 3) Explain one approach for abbreviated MRI for HCC screening as a potential alternative to ultrasound.

RC109B Pancreatic Tumor Evaluation and Follow-up

Participants
Kumaresan Sandrasegaran, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

sandrasegaran.kumaresan@mayo.edu

LEARNING OBJECTIVES

1) Understand pitfalls in diagnosing, staging and post-therapy assessment of pancreatic ductal adenocarcinoma (PDAC). 2) Understand what the surgeon and oncologist want from a staging CT/MRI report. 3) Learn to use standardized reporting template for staging PDAC.

ABSTRACT

This presentation covers the diagnosis and staging of pancreas cancer (pancreatic ductal adenocarcinoma). There are multiple pitfalls in the diagnosis of pancreas cancer and these are highlighted. The staging of pancreas cancer has changed in recent years because of advances in surgical and oncologic therapy. Radiologists need to be aware of these developments, so that accurate information may be reported. The value of standardized reporting is discussed.

RC109C Faster MR Enterography

Participants
Michael S. Gee, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To comprehend the indications for MR enterography. 2) To apply structured interpretation and reporting of MR enterography studies. 3) To apply new techniques for decreasing MR enterography scan time.

ABSTRACT

None.

RC109D Participants Rectal Cancer Staging

Michael H. Rosenthal, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand best practices for MR imaging of rectal cancer at diagnosis. 2) Learn and apply diagnostic criteria to accurately stage rectal adenocarcinomas using MRI. 3) Understand common pitfalls in the interpretation of rectal MRI.

Printed on: 10/29/20

RC110

Liver Sonography 2019: An Update

Sunday, Dec. 1 2:00PM - 3:30PM Room: E350

GI US

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

LEARNING OBJECTIVES

1) Understand the limitations of shear wave liver stiffness measurements. 2) Learn how to recognize inaccurate liver stiffness measurements. 3) Learn how to optimize performing liver stiffness measurements. 3) Recognize specific AP enhancement patterns representative of benign liver tumors. will determine malignancy on the basis of washout following any degree of arterial phase enhancement. 4) Appreciate that CEUS will frequently show washout, discordant with increasing enhancement on CECT or CEMR, on the basis of the purely intravascular microbubble contrast agents for US as compared to interstitial contrast agents for CT and MR scan. 5) Diagnose metastatic disease with optimal detection by sweeping the liver in the portal venous and late phase when metastases are most conspicuous. 6) Understand the rationale for screening and surveillance in HCC. 7) Learn the US LI-RADS categories and management recommendations. 8) Understand the US LI-RADS visualization scores. 9) Understand the role of CEUS in the management of patients sent to ablation therapies in pre-treatment planning, intra-procedural and peri-procedural assessment, and follow-up.

Sub-Events

RC110A Liver Elastography: Pearls and Pitfalls

Participants
Richard G. Barr, MD, PhD, Campbell, OH (*Presenter*) Consultant, Siemens AG; Consultant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, SuperSonic Imagine; Speakers Bureau, Koninklijke Philips NV; Research Grant, Bracco Group; Speakers Bureau, Siemens AG; Consultant, Canon Medical Systems Corporation; Research Grant, Esaote SpA; Research Grant, BK Ultrasound; Research Grant, Hitachi, Ltd

LEARNING OBJECTIVES

1) Understand the limitations of shear wave liver stiffness measurements. 2) Learn how to recognize inaccurate liver stiffness measurements. 3) Learn how to optimize performing liver stiffness measurements.

RC110B Liver Tumors: The Fundamentals of Interpretation with CEUS

Participants
Stephanie R. Wilson, MD, Calgary, AB (*Presenter*) Equipment support, Koninklijke Philips NV; Equipment support, Siemens AG; Equipment support, Samsung Electronics Co, Ltd; Research support, LANDAUER, Inc; Research support, Samsung Electronics Co, Ltd; Speakers Bureau, Koninklijke Philips NV

For information about this presentation, contact:

stephanie.wilson@ahs.ca

LEARNING OBJECTIVES

1) Recognize specific AP enhancement patterns representative of benign liver tumors. will determine malignancy on the basis of washout following any degree of arterial phase enhancement. 2) Appreciate that CEUS will frequently show washout, discordant with increasing enhancement on CECT or CEMR, on the basis of the purely intravascular microbubble contrast agents for US as compared to interstitial contrast agents for CT and MR scan. 3) Diagnose metastatic disease with optimal detection by sweeping the liver in the portal venous and late phase when metastases are most conspicuous.

RC110C Diffuse Liver Disease: HCC Surveillance and LI-RADS

Participants
Aya Kamaya, MD, Stanford, CA (*Presenter*) Royalties, Reed Elsevier; Researcher, Koninklijke Philips NV; Researcher, Siemens AG

LEARNING OBJECTIVES

1) Understand the rationale for screening and surveillance in HCC. 2) Learn the US LI-RADS categories and management recommendations. 3) Understand the US LI-RADS visualization scores.

RC110D CEUS for Liver Lesion Intervention and Follow-up

Participants
Franca Meloni, MD, Milano, Italy (*Presenter*) Research Consultant, Johnson & Johnson; Speaker, Bracco Group

LEARNING OBJECTIVES

1) Understand the role of CEUS in the management of patients sent to ablation therapies in pre-treatment planning, intra-procedural and peri-procedural assessment, and follow-up.

ABSTRACT

• Ultrasound (US) is considered the first imaging modality used to guide percutaneous interventional procedures. CECT and CEMRI are frequently used to assess completeness of ablation. • CEUS is an ideal imaging modality for the management of oncologic patients for clinical diagnostic imaging and interventional work-up during the planning, guidance, and immediate assessment of the treatment and follow-up. • Planning of the treatment includes the assessment of size, number, vascularization and tumor margins of the ablation target. • In pretreatment study, CEUS is complementary to CECT and/or CEMRI for tumor staging. • During the procedure, CEUS can guide the needle insertion in cases of inconspicuity of the target or an occult tumor at unenhanced ultrasound. • At the end of the ablation, multiple artifacts of post-procedure gas are present and require a 10/15 minute wait time for their resolution. When only a few bubbles of gas remain visible, CEUS reinjection permits detection of vascular residual tumor and guidance for immediate retreatment. This approach reduces incomplete ablation from 16 to 6% of cases. • In the assessment of tumor post ablation, the use of CEUS is indicated when CECT or CEMRI are contraindicated or inconclusive. CEUS allows further information on the evaluation of tumor recurrence in both HCC and metastases and should be included in addition to CECT/CEMRI in follow-up protocols.

RC111

Enhancing Your PET/CT Practice

Sunday, Dec. 1 2:00PM - 3:30PM Room: S505AB

CT NM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Sub-Events

RC111A Fluciclovine PET/CT: Interpretation and Case Examples

Participants
David M. Schuster, MD, Decatur, GA (*Presenter*) Institutional Research Grant, Nihon Medi-Physics Co, Ltd; Institutional Research Grant, Blue Earth Diagnostics Ltd; Institutional Research Grant, Advanced Accelerator Applications SA; Institutional Research Grant, Telix Pharmaceuticals Inc; Consultant, Syncona Ltd; Consultant, AIM Specialty Health, Inc; ;

LEARNING OBJECTIVES

1) Describe the mechanism of uptake of the PET radiotracer fluciclovine. 2) Identify normal biodistribution of fluciclovine. 3) Identify the FDA approved clinical indication of fluciclovine. 4) Discuss clinical interpretive criteria of fluciclovine PET.

RC111B DOTATATE PET/CT: Interpretation and Case Examples

Participants
Thomas A. Hope, MD, San Francisco, CA (*Presenter*) Research Grant, General Electric Company; Research Grant, Koninklijke Philips NV; Advisory Board, Ipsen SA; Researcher, Advanced Accelerator Applications SA

For information about this presentation, contact:

thomas.hope@ucsf.edu

LEARNING OBJECTIVES

1) Define somatostatin receptor PET. 2) Examine the circumstances where somatostatin receptor PET should be used in imaging neuroendocrine tumor patients. 3) Describe the false positives and other issues with interpretation somatostatin receptor PET imaging. 4) Explain the use of 177Lu-DOTATATE peptide receptor radionuclide therapy and how imaging is used to select patients.

RC111C Non-oncologic Applications for FDG-PET/CT

Participants
Don C. Yoo, MD, Lexington, MA (*Presenter*) Consultant, inviCRO, LLC

For information about this presentation, contact:

donyoo@brown.edu

LEARNING OBJECTIVES

1) Describe the role of PET/CT in evaluation of infection and inflammation. 2) Determine the role of PET/CT in evaluation of inpatients with fever without a source. 3) Describe the relative imaging costs of various radiopharmaceuticals that can be used for infection and inflammation.

RC111D Effective Reporting and Communication

Participants
Eric M. Rohren, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose

RC112

Peripheral Artery Disease: CTA and MRA (Interactive Session)

Sunday, Dec. 1 2:00PM - 3:30PM Room: S404CD

CT MR VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Constantino S. Pena, MD, Key Biscayne, FL (*Moderator*) Speakers Bureau, Cook Group Incorporated; Speakers Bureau, Medtronic plc ; Speakers Bureau, W. L. Gore & Associates, Inc; Speakers Bureau, Penumbra, Inc; Speakers Bureau, Terumo Corporation; Speakers Bureau, Merit Medical Systems, Inc; Advisory Board, C. R. Bard, Inc; Advisory Board, Boston Scientific Corporation; Stephan Clasen, MD, Tuebingen, Germany (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

stephan.clasen@med.uni-tuebingen.de

Special Information

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

LEARNING OBJECTIVES

1) Describe techniques for acquisition, reconstruction, and image interpretation of peripheral CTA and MRA. 2) Discuss available data and evidence-based results for peripheral CTA and MRA, and expected impact on patient care. 3) Compare advantages and drawbacks of lower extremity CTA and MRA.

Sub-Events

RC112A Interventional Procedure Planning: Role for CTA and MRA

Participants
Constantino S. Pena, MD, Key Biscayne, FL (*Presenter*) Speakers Bureau, Cook Group Incorporated; Speakers Bureau, Medtronic plc ; Speakers Bureau, W. L. Gore & Associates, Inc; Speakers Bureau, Penumbra, Inc; Speakers Bureau, Terumo Corporation; Speakers Bureau, Merit Medical Systems, Inc; Advisory Board, C. R. Bard, Inc; Advisory Board, Boston Scientific Corporation;

LEARNING OBJECTIVES

1) Understand the value of peripheral CTA and MRA. 2) Discuss the benefits of CTA in comparison to MRA in the treatment of PAD. 3) Comprehend the importance of MRA sequences to highlight particular details in peripheral MRA. 4) Understand the importance of image reconstruction for peripheral CTA and MRA.

RC112B Peripheral CTA

Participants
Stephan Clasen, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

stephan.clasen@med.uni-tuebingen.de

LEARNING OBJECTIVES

1) Describe techniques for acquisition, reconstruction, and image interpretation of peripheral CTA. 2) Discuss available data and evidence-based results for peripheral CTA, and expected impact on patient care. 3) Compare advantages and drawbacks of lower extremity CTA in comparison to other imaging modalities and diagnostic tools for arterial occlusive disease.

ABSTRACT

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

RC112C Peripheral MR Angiography

Participants
James C. Carr, MD, Chicago, IL (*Presenter*) Research Grant, Siemens AG; Advisory Board, Siemens AG; Travel support, Siemens AG; Advisory Board, General Electric Company; Speaker, General Electric Company; Research Grant, Bayer AG; Advisory Board, Bayer AG; Travel support, Bayer AG; Speaker, Bayer AG; Research Grant, Guerbet SA; Advisory Board, Guerbet SA; Travel support, Guerbet SA; Speaker, Guerbet SA; Consultant, Circle; Speaker, Circle

RC112D Interventional Complications: Role for CTA and MRA

Participants
Charles Y. Kim, MD, Raleigh, NC (*Presenter*) Consultant, Medtronic plc; Consultant, Humacyte; Consultant, Galvani

For information about this presentation, contact:

charles.kim@duke.edu

LEARNING OBJECTIVES

1) Understand decision making for assessment of stent patency with CTA versus MRA. 2) Describe endovascular aneurysm repair with endografts as well as types of endoleaks and associated implications. 3) Discuss current methods for optimal detection endoleaks with CTA and MRA, with understanding of advantages and disadvantages.

ABSTRACT

Stents are used ubiquitously for the management of atherosclerotic lesions in peripheral arterial disease. While symptomology is an important metric, noninvasive imaging is also a crucial tool for more detailed assessment. Both CTA and MRA have been validated for the assessment of stent patency, although there are nuances for both modalities, and in certain circumstances, one may outperform the other. Imaging of endoleaks has evolved over the past two decades, to include a multitude of techniques with CTA and MRA. While national guidelines for post-EVAR surveillance are relatively unidimensional, it is important for the practicing radiologist to understand the spectrum of available CT and MR techniques for detection of endoleaks, along with the advantages and disadvantages to each approach.

Printed on: 10/29/20

RC113

Pediatric Series: Fetal/Neonatal Imaging

Sunday, Dec. 1 2:00PM - 3:30PM Room: E353B

GU OB PD

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Eva I. Rubio, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose
Amy R. Mehollin-Ray, MD, Pearland, TX (*Moderator*) Nothing to Disclose
Dorothy I. Bulas, MD, Washington, DC (*Moderator*) Editor with royalties, Wolters Kluwer nv

Sub-Events

RC113-01 Fetal Imaging of Spinal Dysraphisms

Sunday, Dec. 1 2:00PM - 2:20PM Room: E353B

Participants
Usha D. Nagaraj, MD, Cincinnati, OH (*Presenter*) Author with royalties, Reed Elsevier

For information about this presentation, contact:

usha.nagaraj@cchmc.org

LEARNING OBJECTIVES

1) To review the differential diagnosis of spinal dysraphisms identified on fetal imaging. 2) Present examples of some of the most commonly diagnosed fetal spinal dysraphisms.

RC113-02 Pre- and Postnatal MRI Findings in Open Spinal Dysraphism Following Intrauterine Repair via Open versus Fetoscopic Surgical Techniques

Sunday, Dec. 1 2:20PM - 2:30PM Room: E353B

Participants
Usha D. Nagaraj, MD, Cincinnati, OH (*Presenter*) Author with royalties, Reed Elsevier
Karin Bierbrauer, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Charles Stevenson, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Jose L. Peiro, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
Foong-Yen Lim, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Beth M. Kline-Fath, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

usha.nagaraj@cchmc.org

PURPOSE

To examine MRI findings of the brain and spine on prenatal and postnatal MRI following prenatal repair of open spinal dysraphism (OSD) by the open and fetoscopic approaches.

METHOD AND MATERIALS

Single center HIPAA compliant and IRB approved retrospective analysis of fetal MRIs with open spinal dysraphism from 1/2011 through 12/2018 that underwent prenatal repair of OSD. Only patients with diagnostic quality postnatal brain and spine MRIs within first 3 months of life were included. Images were reviewed by 2 board certified fellowship-trained pediatric neuroradiologists.

RESULTS

62 patients met inclusion criteria, 47 underwent open repair, 15 underwent fetoscopic repair, average gestational age at initial MRI 22.6 ± 1.4 weeks. 17.7% (11/62) had follow-up fetal MRIs after surgery, 45.5% (5/11) status post open repair and 54.5% (6/11) status post fetoscopic repair. 90.9% (10/11) of these had improved hindbrain herniation status post repair (5/5 open, 5/6 fetoscopic). 54.5% (6/11) had larger lateral ventricular size status post repair (3/5 open, 3/6 fetoscopic), remaining 45.5% (5/11) had stable ventricular size. On postnatal MRI, spinal cord syrinx was seen in 34% (16/47) open repair versus 33.3% (5/15) fetoscopic repair (p=0.96). Degree of postnatal hindbrain herniation by a modified scale (1-4) demonstrated no significant difference in hindbrain herniation between the open (2.6 ± 0.9) versus fetoscopic (2.3 ± 0.7) repair groups (p=0.28). Lateral ventricular size was significantly larger in the open repair (20.9 ± 6.7) versus the fetoscopic repair (16.1 ± 4.9) group (p=0.01).

CONCLUSION

Though lateral ventricular size in the open repair group was larger than the fetoscopic repair group, this can likely be explained by selection criteria used for fetoscopic repair. Other post-operative imaging parameters were not significantly different between the

two groups.

CLINICAL RELEVANCE/APPLICATION

By sharing our experience with fetal and postnatal MRI findings in patients with open spinal dysraphisms undergoing both open and fetoscopic intrauterine repair, we hope to improve our understanding of the disease process and establish the groundwork of what can be expected when evaluating MRIs in this patient population.

RC113-03 Role of Fetal MRI in Diagnosis of Genitourinary Anomalies: Is There an Added Value?

Sunday, Dec. 1 2:30PM - 2:40PM Room: E353B

Participants
Sepideh Sefidbakht, MD, Powel, OH (*Abstract Co-Author*) Nothing to Disclose
Bijan Bijan, MD, Sacramento, CA (*Presenter*) Nothing to Disclose
Hamid Foroutan, Shiraz, Iran (islamic Rep. Of) (*Abstract Co-Author*) Nothing to Disclose
Meisam Hoseinyazdi, Shiraz, Iran (islamic Rep. Of) (*Abstract Co-Author*) Nothing to Disclose
Pedram Keshavarz, Shiraz, Iran (islamic Rep. Of) (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To retrospectively review fetal MRI's performed over 5 years in our center to establish the added value of MRI in diagnosis of fetal GU anomalies.

METHOD AND MATERIALS

IRB approved study. Out of771 fetal MRI's performed in our center, 65 were done either primarily to evaluate a GU anomaly seen in ultrasound or an anomaly related to the GUT was incidentally detected. Interpretation of MRI's were done by a single radiologist who was not blinded to the ultrasound results. Final diagnosis was established through phone calls and national registery search. Post-delivery images also surgical notes and biopsy results were obtained when available. The added value of MRI was discussed with a pediatric surgeon, pediatric urologist, perinatologist and radiologist.

RESULTS

Final diagnoses included bilateral/unilateral renal agenesis(8/4), multicystic dysplastic kidneys(4), urinary tract obstruction(3), duplicate collecting system with obstruction(2), simple renal cyst(3), adrenal cyst(4), posterior urethral valve(5), crossed fused ectopia(1), autosomal recessive/dominant polycystic kidney disease(3/2), glomerulocystic disease(2), bilateral UPJO and isolated mild bilateral pelvocaliectases, normal outcome(25). FMRIwas considered to have an impact on diagnosis/counseling/management in 26(confirming presence/absence of kidneys in severe oligohydramnios (8 & 9), confirming probable normal renal function in hyperintense/hyperechoic fetal kidneys(3), multicystic dysplastic kidney diagnosed as pelvocaliectasis in ultrasound(3), crossed fused ectopia(1), megacystis microcolon(1), &bilateral UPJO(1).

CONCLUSION

Fetal MRI had significant additional benefit to ultrasound in congenital genitourinary anomalies which affected either management (27%) or counseling (12%) as a result of more accurate diagnosis.

CLINICAL RELEVANCE/APPLICATION

While ultrasound is very sensitive in detecting urinary tract abnormalities in the prenatal period, Fetal MRI can add significant clinically relevant data which can affect management and counseling.

RC113-04 Comparison of Mediastinal Shift Angles Obtained with Ultrasound and Magnetic Resonance Imaging in Fetuses with Isolated Left Congenital Diaphragmatic Hernia

Sunday, Dec. 1 2:40PM - 2:50PM Room: E353B

Participants
Chiara Carducci, MD, Rome, Italy (*Presenter*) Nothing to Disclose
Sara Savelli, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Stefano Bascetta, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Anita Romiti, Rome , Italy (*Abstract Co-Author*) Nothing to Disclose
Silvia Salvi, Rome , Italy (*Abstract Co-Author*) Nothing to Disclose
Leonardo Caforio, Rome , Italy (*Abstract Co-Author*) Nothing to Disclose
Paolo Toma, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare ultrasound (US) and magnetic resonance imaging (MRI) in the assessment of mediastinal shift angles (MSA) in fetuses affected by isolated left congenital diaphragmatic hernia (CDH). To investigate the potential role of MRI-MSA and US-MSA as prognostic factors for postnatal survival in fetuses with left CDH.

METHOD AND MATERIALS

This was an observational study of 29 fetuses with prenatally diagnosed isolated left CDH, assessed with both US and MRI examinations between January 2015 and December 2018. The US-MSA measurements performed within two weeks from the MRI assessment were considered for the analysis. The primary outcome was postnatal survival rate.

RESULTS

No significant difference between US and MRI MSA values was detected (p=0.419). Among the 29 cases there were 21 alive infants, for an overall postnatal survival rate of 72.41%. After stratification for postnatal survival, the best cut-offs in terms of sensibility and specificity were 42.1° for US-MSA and 39.1° for MRI-MSA since they have demonstrated the highest discriminatory power between survivors and non-survivors. The performance of MRI-MSA in predicting postnatal survival was close to that of US-MSA in terms of sensitivity (62.5% vs. 50.0%), specificity (80.9% vs. 90.5%), positive predictive value (55.6% vs. 66.7%), negative predictive value (85.0% vs. 82.6%) and accuracy (75.9% vs. 79.3%). There was no statistically significant difference between the two modalities (p > 0.05 for all).

CONCLUSION

MRI and US can be used interchangeably for the assessment of MSA in prenatally diagnosed isolated left CDH. Moreover, MSA measured by both US and MRI was confirmed to be correlated with perinatal outcome in terms of survival.

CLINICAL RELEVANCE/APPLICATION

Mediastinal shift angle is a simple, quick and repeatible US and MRI measurement that seems to be a promising diagnostic tool in predicting survival in prenatally diagnosed left CDHs.

RC113-05 Fetal MRI Assessment of Mediastinal Shift Angle (MSA) in Isolated Left Congenital Diaphragmatic Hernia: A New Postnatal Survival Predictive Tool?

Sunday, Dec. 1 2:50PM - 3:00PM Room: E353B

Participants
Stefano Bascetta, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Sara Savelli, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Chiara Carducci, MD, Rome, Italy (*Presenter*) Nothing to Disclose
Milena Viggiano, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Enza Carnevale, MD, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose
Leonardo Caforio, Rome , Italy (*Abstract Co-Author*) Nothing to Disclose
Paolo Toma, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To quantify mediastinal shift angle (MSA) in isolated left congenital diaphragmatic hernia (CDH) by fetal MRI and to assess the feasibility of MSA in predicting postnatal survival at discharge.

METHOD AND MATERIALS

A prospective database including fetuses with CDH who underwent fetal MRI from January 2013 to January 2018 was retrospectively reviewed and fetuses from singleton pregnancies with isolated left CDH were selected. Cases were matched for gestational age with controls from singleton fetuses without thoracic, cardiac or mediastinal malformations. For all fetuses MSA was determined twice by two experienced operators (MSA1 and MSA2). Interoperator variability and statistical difference between MSA values in cases and controls were investigated. Total Fetal Lung Volume (TFLV) was also determined in cases and correlation between MSA and TFLV was assessed. Furthermore cases were divided into two groups based on postnatal survival (group 1-survivor, group 2-non survivor) and predictive value of MSA was determined.

RESULTS

From a total of 56 fetuses with prenatal diagnosis of CDH in our database, 34 fetuses with isolated left CDH were included as cases and matched with 42 fetuses as controls. 24 cases survived until discharge (G1) and 10 didn't (G2). An excellent interoperator reliability was obtained in measuring MSA (0.985, interclass correlation coefficient 98% , CI 0.7-1.000) with a statistically significant difference between MSA values in cases and controls. After survival stratification of cases statistical analysis confirmed an inverse correlation between MSA values and survival (p value <0.0001) and a direct correlation between TFLV and survival (p value <0.005), as well as a statistically significant inverse correlation between MSA and TFLV. Area under the ROC curve detected an excellent discriminatory accuracy for MSA in separating survivor and non-survivor (0.931, 95%, CI 0.851-1.000) with the best cutoff at 38.2°.

CONCLUSION

MSA is a promising tool for correlation with postnatal survival in patients with isolated left CDH, alone or in association with TFLV. The possible prognostic role of MSA should be investigated also for early treatments in utero or at birth in future clinical trials.

CLINICAL RELEVANCE/APPLICATION

Mediastinal shift angle can be easily assessed by fetal MRI, it is correlated with pulmonary volume and it could predict survival in left CDH redefining the objectives of future clinical trials.

RC113-06 The Normal Fetal Lung Volume: One Size Does Not Fit All Populations

Sunday, Dec. 1 3:00PM - 3:10PM Room: E353B

Participants
Sepideh Sefidbakht, MD, Powel, OH (*Abstract Co-Author*) Nothing to Disclose
Amin Dehdashtian, MD, Shiraz, Iran (islamic Rep. Of) (*Abstract Co-Author*) Nothing to Disclose
Fereshteh Bagheri, Shiraz, Iran (islamic Rep. Of) (*Abstract Co-Author*) Nothing to Disclose
Pedram Keshavarz, Shiraz, Iran (islamic Rep. Of) (*Abstract Co-Author*) Nothing to Disclose
Bijan Bijan, MD, Sacramento, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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PURPOSE

To measure the lung volume using fetal MR images in normal fetuses; in order to establish gestational age-dependent reference data in our population.

METHOD AND MATERIALS

342 fetuses that underwent fetal MRI in our institution during Jan 2016-2017 (gestational age 18-36 weeks). All MRI's were done on a 1.5T Seimens Avanto. 241 fetuses were proven to have normal lung structure and function post-delivery and had technically adequate images for evaluation of the lungs. Fetal lung volumes were measured by manual tracing of consecutive slices on T2 HASTE, or trufisp images in axial planes, whichever was technically acceptable. The volumes were correlated with gestational age. This resulted in a formula calculating the expected fetal lung volume dependent using gestational age.

RESULTS

Normal FLV increased with gestational age. The expected fetal lung volume was derived from the following formula: Fetal lung volume (mL) = 0.002× (GA^2.913), in which GA is the gestational weeks. Our data distribution was closest to Osada et al. rather than Rypens et al and Meyers et al.

CONCLUSION

Fetal lung volumes correlate with gestational age. The exact relationship between lung volumes and gestational age might vary in different populations.

CLINICAL RELEVANCE/APPLICATION

Fetal lung volumes have prognostic significance. In some common anomalies such as congenital diaphragmatic hernia the expected fetal lung volume is used for clinical management and decision-making. Accurate population-specific data is necessary for accurate risk stratification and management in these cases.

RC113-07 The Fetal Airway: In Utero Imaging, Decision Making, and Surgical Planning

Sunday, Dec. 1 3:10PM - 3:30PM Room: E353B

Participants
Mariana L. Meyers, MD, Aurora, CO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the normal fetal airway appearance by fetal MRI and ultrasound Identify the main imaging features of fetal neck and chest pathologies affecting the airway. 2) Recognize how fetal MRI aids in the diagnosis of different neck pathologies.

RC114

Peripheral and Visceral Occlusive Disease

Sunday, Dec. 1 2:00PM - 3:30PM Room: S103AB

VA IR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Bulent Arslan, MD, Oak Brook, IL (*Moderator*) Advisory Board, Medtronic plc; Advisory Board, Guerbet SA; Speakers Bureau, Biocompatibles International plc; Speakers Bureau, C. R. Bard, Inc; Advisory Board and Speakers Bureau, Boston Scientific Corporation; Speakers Bureau, Penumbra, Inc
Minhaj S. Khaja, MD, MBA, Ann Arbor, MI (*Moderator*) Consultant, Penumbra, Inc; Speaker, Penumbra, Inc

LEARNING OBJECTIVES

1) Describe pros and cons of intervention for median arcuate ligament compression on the celiac axis. 2) Review clinical presentation and endovascular treatment options for acute and subacute portal vein thrombus. 3) Outline three recommendations for endovascular treatment of peripheral vascular disease. 4) Describe how and when to intervene in patients with mesenteric ischemia. 5) Describe two vascular compression syndromes.

Sub-Events

RC114A Compressive Arterial Syndromes

Participants
Minhaj S. Khaja, MD, MBA, Ann Arbor, MI (*Presenter*) Consultant, Penumbra, Inc; Speaker, Penumbra, Inc

LEARNING OBJECTIVES

1) Describe compressive arterial syndromes. 2) Understand role of diagnostic or therapeutic interventions in patients with these syndromes.

RC114B Treatment of Visceral Aneurysms

Participants
Jordan C. Tasse, MD, Chicago, IL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the clinical presentation and diagnosis of visceral aneurysms. 2) Describe endovascular and surgical approaches to the management of visceral aneurysms. 3) Illustrate case based examples of their endovascular treatment.

RC114C Advanced Arterial Revascularization

Participants
Sreekumar Madassery, MD, Chicago, IL (*Presenter*) Speakers Bureau, Cook Group Incorporated Speakers Bureau, Penumbra, Inc Speakers Bureau, Abbott Laboratories Consultant, C. R. Bard, Inc

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LEARNING OBJECTIVES

1) Understand current changes and management of femoropopliteal disease interventions in light of drug coated/drug eluting device issues. 2) Describe advanced tibopedal interventions for critical limb ischemia patients. 3) Comprehend new endovascular options for 'no-option' patients.

RC114D Below-the-Knee Interventions

Participants
Ryan C. Schenning, MD, Portland, OR (*Presenter*) Nothing to Disclose

RC114E Renovascular Occlusive Disease: Current Paradigm

Participants
Bulent Arslan, MD, Oak Brook, IL (*Presenter*) Advisory Board, Medtronic plc; Advisory Board, Guerbet SA; Speakers Bureau, Biocompatibles International plc; Speakers Bureau, C. R. Bard, Inc; Advisory Board and Speakers Bureau, Boston Scientific Corporation; Speakers Bureau, Penumbra, Inc

RC115

Advanced MRI Applications

Sunday, Dec. 1 2:00PM - 3:30PM Room: E353C

BR MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Christopher E. Comstock, MD, New York, NY (*Moderator*) Nothing to Disclose

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Sub-Events

RC115A AB-MRI

Participants
Christopher E. Comstock, MD, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe the concept of Abbreviated Breast MRI (AB-MR) in screening average risk women with dense breasts. 2) Review the current data on the performance of AB-MR compared to DBT and WBUS. 3) Appropriately characterize lesions found on AB-MR and improve interpretation accuracy.

RC115B Ultrafast MRI

Participants
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Presenter*) Researcher, Siemens AG Researcher, Seno Medical Instruments, Inc Researcher, Identification Solutions, Inc Researcher, Micrima Limited Researcher, Medtronic plc Scientific Advisor, ScreenPoint Medical BV Scientific Advisor, Transonic Imaging, Inc Stockholder, Transonic Imaging, Inc

LEARNING OBJECTIVES

1) To design a breast MRI protocol incorporating ultrafast breast MRI. 2) To learn how to interpret ultrafast breast MRI. 3) To understand the clinical value of ultrafast breast MRI in lesion detection and classification.

RC115C DWI and Multiple Parametric Imaging

Participants
Katja Pinker-Domenig, MD, New York, NY (*Presenter*) Speakers Bureau, Siemens AG ; Advisory Board, Merantix Healthcare GmbH

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LEARNING OBJECTIVES

1) Describe the principle of DWI of the breast. 2) Define the basic requirements for the clinical application of DWI in breast imaging. 3) Understand the role of DWI as an essential part of a multiparametric breast MRI protocol. 4) Use multiparametric breast MRI in clinical practice.

ABSTRACT

Magnetic resonance imaging (MRI) of the breast is undisputedly the most sensitive imaging method to detect cancer, with a higher detection rate than mammography, digital breast tomosynthesis, and ultrasound. To overcome limitations of dynamic contrast-enhanced (DCE) MRI in specificity, additional functional MRI parameters have been explored, with diffusion-weighted imaging (DWI) emerging as the most robust and reliable. In DWI, the random movement of water molecules in body tissue can be visualized and quantified by calculating the apparent diffusion coefficient (ADC). Malignancies typically show restricted water molecule diffusivity with higher signal on DWI images and lower signal on ADC maps due to increased cell density, which leads to compression of extracellular space and microstructural changes. Breast DWI can be easily combined with DCE-MRI in every breast MRI protocol without substantially increasing the total scan time, an approach defined as multiparametric MRI. Several studies have demonstrated that multiparametric MRI of the breast with DCE-MRI and DWI can provide a high sensitivity, specificity, and diagnostic accuracy, obviating unnecessary breast biopsies in benign breast tumors. It is therefore increasingly being implemented in clinical routine for an improved cancer detection, characterization and treatment response assessment. Other functional MRI parameters are currently under investigation for the clinical implementation in a multiparametric MRI concept. This presentation aims to provide a comprehensive overview of the current applications and challenges of multiparametric MRI of the breast in the clinical setting.

RC116

Moving Past Burnout: Strategies Beyond Individual Interventions to Mitigate Work-related Stress and Promote Physician Wellness in Radiology (Sponsored by the RSNA Professionalism Committee)

Sunday, Dec. 1 2:00PM - 3:30PM Room: S503AB

LM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Rama S. Ayyala, MD, Providence, RI (*Moderator*) Nothing to Disclose
Brandon P. Brown, MD, Indianapolis, IN (*Moderator*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the manifestations of burnout and recognize organizational causes that can be addressed to mitigate it. 2) Discuss the role of leadership in fostering a collegial and effective team to combat burnout and promote job satisfaction. 3) Describe the importance of a positive departmental culture in building physician resiliency as a long-term strategy to prevent burnout.

ABSTRACT

"Burnout" has been defined as psychological syndrome that arises in stressful work environments, has is frequently defined by three dimensions: emotional exhaustion, depersonalization, and perceived lack of accomplishment. In 2018, a survey of over 15000 physicians in 25 medical specialties showed that burnout among radiologists has climbed from the 18th to the 7th highest rate of burnout amongst all physicians, since a previous survey performed in 2013 (1). Burnout in medicine can be detrimental to quality and safety of patient care, and can lead to job dissatisfaction, decreased productivity, high physician turnover, and ultimately can contribute to physician shortages and increasing health care costs (2). Another critical consequence of burnout in medicine is the impact on physician mental health, with studies showing burnout associated with increased depression, substance abuse, and suicide in physicians (3). Although awareness of work-related stress in medicine has been present for decades, more recent changes to patterns of patient care through technological advances such as the electronic medical record (EMR) and Picture Archiving and Communication Systems (PACS), have increased that burden of stress. These innovations have certainly improved aspects of patient care, however they have also contributed to two potential causes of burnout such as heightened sense of isolation and sedentary work environments. In light of the increasing awareness of this issue in radiology, this refresher course, sponsored by the RSNA Professionalism Committee, will highlight organizational strategies can be developed and implemented to mitigate the sources of burnout, in order to help radiologists rediscover joy in their work and the satisfaction that can come through awareness of our impact.

Sub-Events

RC116A Organizational Causes of Burnout

Participants
Rama S. Ayyala, MD, Providence, RI (*Presenter*) Nothing to Disclose

ABSTRACT

Previous literature on burnout in radiology have acknowledged that while some causative factors are individually driven, the most impactful are organizational/departmental causes of burnout. Each radiology organization/department has varying structures and cultures. Therefore, factors contributing will vary. Studies have shown that organizational directed interventions are more effective long term to combat burnout than individual directed interventions alone. This session will highlight various organizational/departmental causes of burnout to consider to effectively address this important issue.

RC116B The Role of Leadership: Creativity as an Antidote to Disengagement

Participants
Reed A. Omary, MD, Nashville, TN (*Presenter*) Nothing to Disclose

ABSTRACT

Many causes of work-related stress that have been articulated in the literature and in published surveys described the role of healthcare administration and department/group leadership in impacting radiologist engagement and wellness. This session will focus on creativity and imagination, and their ability to inspire and give physicians the opportunity to reconnect with the most fulfilling components of healthcare.

RC116C The Role of Leadership: Identifying the "Yellow Lights"

Participants
Cheri L. Canon, MD, Birmingham, AL (*Presenter*) Royalties, The McGraw-Hill Companies; Consultant, Bracco Group

ABSTRACT

There are many who look to Group/Departmental leadership as key to the solution for burnout, and to impacting radiologist

engagement and wellness. Some have argued that the metrics by which radiologists are measured can themselves be a cause of burnout. This session will focus on the ways in which leaders can recognize and mitigate the early stages of work-related stress, even before they have reached a critical point.

RC116D How to Build a Departmental/Group Culture of Wellness

Participants
Brandon P. Brown, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose

ABSTRACT

Many discussions of burnout have focused on the individual physician - strategies for personal resilience and health. Other commentators have emphasized the need for administrative initiatives, beginning with the Hospital "C suite." Yet there is a third level, not contained by the prior two, which is to focus on the local culture in the group or division. How can we foster an environment in which radiologists are best able to support and balance one another? What does it mean to be a colleague, as opposed to merely a "co-worker?" How might true collaboration appear, in which physicians are enabled to depend upon one another, rather than compete? This session will explore the answers to these questions, and discuss the ways in which the radiology team can contribute to one another's well-being.

Printed on: 10/29/20

RC117

Emerging Technology: Imaging of Dementias and Movement Disorders Update 2019

Sunday, Dec. 1 2:00PM - 3:30PM Room: S504CD

CT MR NR NM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Rathan M. Subramaniam, MD,PhD, Dunedin, New Zealand (*Moderator*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To review the value of FDG and amyloid PET/CT in diagnosis of dementia. 2) To review the value of MR imaging in diagnosis of dementia. 3) To review the value of tau PET/CT in diagnosis of dementia.

ABSTRACT

This session will review the importance and value of FDG PET, Amyloid PET, MRI and Tau PET imaging in diagnosis of dementia.

Sub-Events

RC117A Imaging Dementias: FDG and Amyloid PET/CT

Participants
Rathan M. Subramaniam, MD,PhD, Dunedin, New Zealand (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand which FDA approved MR techniques are currently available for improving differential diagnosis in patients with dementia. 2) Improve basic knowledge of how MR results correspond to clinical dementia phenotypes. 3) Discuss recent technological advances including applications of dynamic susceptibility contrast (DSC) MR, arterial spin labelling (ASL) and resting state functional connectivity MRI (rs-fcMRI) in the setting of patients with dementia.

RC117B Imaging Dementias - Tau PET/CT: Update 2019

Participants
Val J. Lowe, MD, Rochester, MN (*Presenter*) Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Eli Lilly and Company; Advisory Board, Merck & Co, Inc

LEARNING OBJECTIVES

1) Describe the basic science principles behind tau PET/CT imaging. 2) Understand the utility of tau PET/CT imaging in neurodegenerative disease. 3) Identify the findings of a positive tau PET/CT scan.

RC117C Imaging of Movement Disorders: Update 2019

Participants
Kevin P. Banks, MD, Joint Base San Antonio , TX (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the Parkinsonian Syndrome entities and their clinical features. 2) Analyze the role and efficacy of I-123 Ioflupane Brain SPECT in the diagnosis and management of PS. 3) Learn the essential steps of proper exam preparation and acquisition. 4) Comprehend the interpretation criteria for I-123 Ioflupane Brain SPECT and potential pitfalls.

RC118

Interactive Game: Cases in Body Oncologic Imaging that I Have Learned the Most From (Interactive Session)

Sunday, Dec. 1 2:00PM - 3:30PM Room: S102CD

CT MR OI US

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Deborah J. Rubens, MD, Rochester, NY (*Moderator*) Nothing to Disclose

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Special Information

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

Sub-Events

RC118A Ultrasound

Participants
Deborah J. Rubens, MD, Rochester, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review some commonly performed examinations where US leads to oncologic diagnosis. 2) Identify those technical parameters which are critical to accurate ultrasound performance, especially color and spectral Doppler, as exemplified by pitfalls and 'missed' cases. 3) Explore the role of US in management of oncologic patients, including contrast enhanced ultrasound.

RC118B Computed Tomography

Participants
Christine O. Menias, MD, Chicago, IL (*Presenter*) Royalties, Reed Elsevier

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menias.christine@mayo.edu

LEARNING OBJECTIVES

1) Review CT imaging features of challenging abdominal and pelvic oncologic cases encountered in clinical practice using case-based examples. 2) Highlight the imaging pearls and pitfalls that may impact diagnosis and treatment. 3) Discuss potential differential diagnoses and mimics of oncologic abdominal and pelvic cases.

RC118C Magnetic Resonance Imaging

Participants
Richard Kinh Gian Do, MD,PhD, New York, NY (*Presenter*) Consultant, Bayer AG; Author, Reed Elsevier; Spouse, Author, Wolters Kluwer nv; Spouse, Data Monitoring Committee, Alk Abello

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LEARNING OBJECTIVES

1) Assess the role of diffusion weighted imaging in oncology. 2) Explain the presence of susceptibility artifacts on different MRI sequences. 3) Compare the use of extracellular and hepatobiliary contrast agents for liver MRI.

RC118D PET/CT

Participants
Luigi Aloj, MD, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Biochemical characterisation of cancer through PET imaging.2) How combinations of radiopharmaceuticals may be relevant to diagnosis.3) Tumour heterogeneity as detected by PET and implications for patient management.4) The role of PET/CT in theragnostics

Printed on: 10/29/20

RC120

What's New in the Treatment of Brain Metastases?

Sunday, Dec. 1 2:00PM - 3:30PM Room: S501ABC

NR OI RO

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Timothy J. Kruser, MD, Chicago, IL (*Moderator*) Speakers Bureau, AstraZeneca PLC

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Sub-Events

RC120A Role of Hippocampal Sparing WBRT

Participants
Vinai Gondi, MD, Warrenville, IL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the biology, radiation sensitivity, and cognition specificity of hippocampal neurogenesis. 2) Examine practice-changing data supporting the use of hippocampal sparing during whole-brain radiotherapy for brain metastases. 3) Identify clinical scenarios that may favor adoption of hippocampal sparing whole brain radiotherapy.

RC120B Role of SRS Treatment

Participants
Timothy J. Kruser, MD, Chicago, IL (*Presenter*) Speakers Bureau, AstraZeneca PLC

For information about this presentation, contact:

tkruser@nm.org

LEARNING OBJECTIVES

1) Identify clinical factors that may favor radiosurgery versus whole brain RT. 2) Examine the impact of combining radiosurgery with targeted medical therapies on local control. 3) Estimate the likelihood of radiation necrosis and local failure following SRS +/- immunotherapy.

RC120C MR Imaging for Brain Metastases

Participants
Timothy J. Kaufmann, MD, Rochester, MN (*Presenter*) Consultant, SpineThera

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Review current Response Assessment in Neuro-Oncology Brain Metastases guidelines. 2) Examine common MRI patterns of radionecrosis, tumor progression, and pseudoprogression after radiosurgery. 3) Review imaging changes of brain metastases treated with immunotherapy. 4) Appraise the value and limitations of special imaging modalities (perfusion, permeability, DWI, spectroscopy, SPECT) on differentiating tumor progression from radionecrosis.

RC120D PET Imaging for Brain Metastases

Participants
Norbert Galldiks, MD, Cologne, Germany (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the most important PET tracers for imaging of brain metastases. 2) Review the value of PET for the differentiation of treatment-related changes related to radiotherapy, immunotherapy and combinations thereof from brain metastases recurrence. 3) Review the potential of PET for treatment response assessment.

RC121

Innovations in Hybrid Imaging

Sunday, Dec. 1 2:00PM - 3:30PM Room: E351

CT MR NM PH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Osama R. Mawlawi, PhD, Houston, TX (*Coordinator*) Research Grant, General Electric Company Research Grant, Siemens AG

For information about this presentation, contact:

omawlawi@mdanderson.org

LEARNING OBJECTIVES

1) Become more proficient with the latest innovations in PET/CT imaging and their impact of scanner performance. 2) Learn about the challenges and opportunities in PET/MR image quantification and potential clinical applications. 3) Understand the various corrections necessary to generate a quantifiable SPECT image.

ABSTRACT

This sesion will cover the latest innovations in hybrid immaging. The session will have three speakers covering 3 different topics. The first talk will cover the latest in PET/CT imaging including silicon photomultiplier tubes, larger axial fields of view and the effects these innovations have on scanner performance. The second talk will focus on PET/MR imaging and disuss the challenges and opportunities of PET/MR image quantification and potential clinical applications. Finally, the third talk will focus on SPECT/CT image quantification while discussing the various correction factors and processes needed to to generate a quantifiable SPECT image.

Sub-Events

RC121A Innovations in PET/CT

Participants
Osama R. Mawlawi, PhD, Houston, TX (*Presenter*) Research Grant, General Electric Company Research Grant, Siemens AG

For information about this presentation, contact:

omawlawi@mdanderson.org

LEARNING OBJECTIVES

1) List the latest advances in PET/CT imaging. 2) Understand the impact of these innovations on scanner performance and image quality. 3) Recognize the differences between commercial PET/CT systems with respect to these innovations.

ABSTRACT

This talk will focus on the latest innovations in PET/CT imaging. Topics covered will include silicon photomultiplier (SiPM) tubes, large axial PET scanners, data driven gating, and the impact these innovations have on scanner performance and image quality.

RC121B Opportunities in PET/MR

Participants
Thomas Beyer, PhD, Vienna, Austria (*Presenter*) Co-founder cmi-experts GmbH; Co-founder Dedicaid GmbH

For information about this presentation, contact:

thomas.beyer@meduniwien.ac.at

LEARNING OBJECTIVES

1) Appreciate benefits and challenges of quantification in PET. 2) Be made aware of the basic principles of fully-integrated PET/MR imaging systems. 3) Understand the fundamental challenges and potential of MR-guided PET quantification. 4) Be pointed to potential applications of fully-integrated PET/MR in clinical research, and possibly routine.

ABSTRACT

PET is a non-invasive imaging technique that provides reproducible and fully-quantitative information on preselected metabolic/signaling pathways. PET is highly sensitive, thus, requiring only small amounts of biomarkers to be used for visualization and quantification purposes. By comparison to high-resolution anatomical images PET images appear blurred, which is attributed to the positron range effects and the limited detector size of the PET ring systems.Today, clinical PET imaging systems are offered almost exclusively in combination with CT and MR systems. Combined PET/MR, in particular, offers a number of intrinsic methodological advantages over PET only. These include, the use of MR imaging (e.g., by means of MR navigators) to estimate involuntary patient motion as a pre-requisite for motion compensation, and, thus, subsequent improvement of PET image quality and quantification. Following appropriate motion compensation, PET data can be improved in quality and accuracy through the use of MR-guided partial volume corrections and image reconstruction. In this presentation we will highlight the most important advances of PET instrumentation and data processing that help facilitate fully-integrated PET/MR in the first place, and draw a

benefit from this integration for the PET data. This includes a brief discussion of the effect of the static MR field on positron range effects, in particular for higher-energetic positron emitters. Overall, increase volume sensitivity helps reduce the amount of radiotracer injected into patients or shorten the emission scan time, in combination with increased signal-to-noise in the emission images (thanks to the use of time-of-flight, a concept different from TOF-MR) it helps increase sensitivity and reader accuracy of PET images. Lastly, advances in image reconstruction have brought the level of PET, and the appearance of the PET images, closer to the common understanding of radiologically useful images.

RC121C SPECT/CT Quantitation

Participants
Srinivas C. Kappadath, PhD, Houston, TX (*Presenter*) Research Grant, General Electric Company; Research Grant, BTG International Ltd; Consultant, BTG International Ltd; Consultant, ABK Biomedical Inc; Consultant, Terumo Corporation

For information about this presentation, contact:

skappadath@mdanderson.org

LEARNING OBJECTIVES

1) Identify the various correction factors applied to SPECT. 2) Understand the processes used for quantification of SPECT. 3) Describe the various approaches used commercially for SPECT quantitation.

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RC122

Dual Energy CT for Radiotherapy Applications

Sunday, Dec. 1 2:00PM - 3:30PM Room: S504AB

CT PH RO

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Kristy K. Brock, PhD, Houston, TX (*Moderator*) License agreement, RaySearch Laboratories AB; Grant support, RaySearch Laboratories AB; Research support, Mirada Medical Ltd; ;

Sub-Events

RC122A Clinical Need for Dual Energy CT in Proton Radiotherapy

Participants
Jon J. Kruse, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn about calibration of Hounsfield Units for determination of relative stopping power for proton therapy planning. 2) Discuss potential sources of error in stopping power determination. 3) Describe treatment planning strategies to mitigate range uncertainties in proton therapy planning.

RC122B State of the Art in Dual Energy CT Technology

Participants
Michael Lawless, PHD, Madison, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain basic dual-energy CT principles. 2) Compare current dual-energy CT techniques and associated limitations.

ABSTRACT

With dual-energy computed tomography (DECT), an additional measurement is obtained, allowing for the reconstruction of supplementary information, such as relative electron density and effective atomic number information. The additional information gained through DECT has potential to aid in several aspects of the radiation therapy process, including improving dose calculation accuracy for proton therapy. This course will discuss the basic principles of DECT and compare different vendor solutions for acquisition of DECT images.

RC122C Technical Challenges in the Integration of Dual Energy CT into Radiotherapy Treatment Planning

Participants
Jon J. Kruse, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Compare range uncertainty to other sources of dosimetric error in proton therapy. 2) Observe clinical examples of range variation in proton therapy.

RC123

Making Patients and Staff Safer in Interventional Procedures

Sunday, Dec. 1 2:00PM - 3:30PM Room: E353A

IR PH SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
William F. Sensakovic, PhD, Scottsdale, AZ (*Coordinator*) Founder, Telerad Physics Teaching, LLC
Thaddeus A. Wilson, PhD, Madison, WI (*Coordinator*) Nothing to Disclose

For information about this presentation, contact:

wfsensak@gmail.com

LEARNING OBJECTIVES

1) Describe cataract and cancer risks associated with typical interventional radiology procedures and workload. 2) Develop and assess institutional policies for implementing radiation dose tracking and auditing in the interventional setting.

Sub-Events

RC123A Patient Doses (in lab) and Patient Dose Management

Participants
Stephen Balter, PhD, New York, NY (*Presenter*) Speakers Bureau, MAVIG, GmbH

LEARNING OBJECTIVES

1) Understand how in-lab radiation displays and post-procedure radiation use data can be used to optimize patient safety.

Active Handout:Stephen Balter

http://abstract.rsna.org/uploads/2019/18001937/Active RC123A.pdf

RC123B Staff Protection: Cataract and Potential Cancers

Participants
Madan M. Rehani, PhD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain the results from the studies among interventionalists and support staff on eye lens opacities and comprehend the risks. 2) Identify the evidence or lack thereof of cancer risk among interventionalists. 3) Identify the protective measures for staff in interventional suites.

RC123C Dose Tracking and Audits: Institution-wide Program

Participants
Pei-Jan P. Lin, PhD, Richmond, VA (*Presenter*) Nothing to Disclose
Shelia Regan, MEd, Richmond, VA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

shelia.regan@vcuhealth.org

LEARNING OBJECTIVES

1) Learn how the 'event-by-event' RDSR data exported from the patient radiation dose monitoring and tracking (PRDMT) systems may be employed to better estimate the peak skin dose (PSD) from fluoroscopy equipment. 2) The estimated PSD is then classified into three 'alert level' which leads to a better patient care through a follow up process which will be described in detail at the presentation. 3) Identify establishment of a Clinical Radiation Safety Office (CRSO) to handle the technical aspect of PRDMT and administrative processes of 'documentation' and 'patient follow up' is the key to a successful patient care. 4) It is necessary to establish CRSO as an enterprise wide office to govern the entire process and functions provided by the CRSO. It is essential to learn that successful PRDMT requires both the 'organization' must be setup and it must be properly staffed with qualified 'personnel'.

ABSTRACT

The internal organization structure is described in detail including the 'alert Levels' and what comes next upon receiving the alerts. The Clinical Radiation Safety Office (CRSO) established at VCU Medical Center plays major key rolls in (1) the patient radiation dose monitoring and tracking (PRDMT) and (2) follow up of patients who receved 'confirmed' peak skin dose that is required by the Hospital Policy to follow post fluoroscopy examinations as part of VCU's patient care. The key is to establish a Clinical Radiation Safety Office which manage the technical aspect of PRDMT and follow up of patients process. In other words, an institutinal, enterprise wide organization must be created to handle the total patient care for patients who received high dose radiation which could result in deterministic injury.

Active Handout:Shelia Regan

http://abstract.rsna.org/uploads/2019/18001939/Active RC123C.pdf

Active Handout:Shelia Regan

http://abstract.rsna.org/uploads/2019/18001939/Active RC123C.pdf

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RC124

Publishing in RSNA Journals: Tips from the Editors

Sunday, Dec. 1 2:00PM - 3:30PM Room: S401CD

ED

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
David A. Bluemke, MD,PhD, Bethesda, MD (*Moderator*) Nothing to Disclose
Jeffrey S. Klein, MD, Burlington, VT (*Moderator*) Editor with royalties, Wolters Kluwer nv

For information about this presentation, contact:

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laurabancroftmd@gmail.com

LEARNING OBJECTIVES

1) Identify the appropriate RSNA journal for my scholarly work. 2) Understand the process used by each RSNA journal to evaluate submitted material. 3) List steps I can take to maximize my likelihood of acceptance of my manuscript. 4) Learn how to address revision requests of rejected manuscripts with opportunity to resubmit. 5) Know how to become more involved with the RSNA publications.

ABSTRACT

The RSNA family of peer-reviewed journals now comprises five distinct publications: Radiology, RadioGraphics, and three new online journals: Radiology: Artificial Intelligence, Radiology: Cardiothoracic Imaging, and Radiology: Imaging Cancer. With the debut of three new online RSNA journals in 2019, there is now an expanded opportunity for authors of radiology and related manuscripts to publish their scholarly work with the RSNA. In this presentation the RSNA journal editors will each provide details on the type of material they consider for publication and the processes each uses to evaluate submitted articles and related materials. There will be ample opportunity to ask questions of each editor and learn how to become involved in different aspects of the RSNA journals.

Sub-Events

RC124A Radiology

Participants
David A. Bluemke, MD,PhD, Bethesda, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

dbluemke@rsna.org

RC124B Radiology: Artificial Intelligence

Participants
Charles E. Kahn JR, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ckahn@upenn.edu

LEARNING OBJECTIVES

1) Learn about the goals, organization, and content of RSNA's new Radiology: Artificial Intelligence journal. 2) Describe the manuscript types and their requirements. 3) Understand how to be a successful author or reviewer for the journal.

Active Handout:Charles E. Kahn

http://abstract.rsna.org/uploads/2019/19001856/Active RC124B.pdf

RC124C Radiology: Cardiothoracic Imaging

Participants
Suhny Abbara, MD, Dallas, TX (*Presenter*) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

LEARNING OBJECTIVES

To review the composition and structure of the RCTI editorial board.

RC124D Radiology: Imaging Cancer

Participants
Gary D. Luker, MD, Ann Arbor, MI (*Presenter*) Research Grant, Polyphor, Ltd; Consultant, Polyphor, Ltd

For information about this presentation, contact:

gluker@med.umich.edu

LEARNING OBJECTIVES

1) Describe the scope of content and editorial practices of Radiology: Imaging Cancer.

Active Handout:Gary Dean Luker

http://abstract.rsna.org/uploads/2019/19001858/Active RC124D.pdf

RC124E **RadioGraphics**

Participants
Jeffrey S. Klein, MD, Burlington, VT (*Presenter*) Editor with royalties, Wolters Kluwer nv

For information about this presentation, contact:

jklein@rsna.org

LEARNING OBJECTIVES

1) List the details of the process by which content for *RadioGraphics* is identified and solicited.

RC125

Quantitative Imaging: Promise and Challenges

Sunday, Dec. 1 2:00PM - 3:30PM Room: S404AB

BQ PH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Michael F. McNitt-Gray, PhD, Los Angeles, CA (*Coordinator*) Institutional research agreement, Siemens AG

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mmcnittgray@mednet.ucla.edu

LEARNING OBJECTIVES

1) Describe the need for and benefits of implementing quantitative image analyses in clinical trials and clinical practice. 2) Understand the activities that RSNA supports to help move the profession of radiology from a primarily qualitative interpretation paradigm to a more quantitative-based interpretation model. 3) Describe the current status of the NCI's Quantitative Imaging Network and the nature and purpose of research efforts in this area. 4) Describe the role and potential of quantitative imaging in clinical trials and specific activities undertaken within some Clinical Trials Networks.

Sub-Events

RC125A The Perspective of the RSNA Quantitative Imaging Biomarker Alliance (QIBA)

Participants
Timothy J. Hall, PhD, Madison, WI (*Presenter*) Equipment support, Siemens AG; Technical support, Siemens AG; Researcher, F.K.A. Gammex RMI; Researcher, Sun Nuclear Corporation

LEARNING OBJECTIVES

1) Describe the need for and benefits of implementing quantitative image analyses in clinical trials and clinical practice. 2) Describe the key challenges of extracting uniform, standardized quantitative measures from clinical imaging scans. 3) Provide examples of approaches to resolving of these challenges. 4) Understand the activities that RSNA supports to help move the profession of radiology from a primarily qualitative interpretation paradigm to a more quantitative-based interpretation model.

RC125B NCI's Quantitative Imaging Network (QIN) Perspective

Participants
Robert J. Nordstrom, PhD, Rockville, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

nordstrr@mail.nih.gov

LEARNING OBJECTIVES

1) The challenges of transitioning quantitative imaging tools from development verification to clinical validation. 2) How the Quantitative Imaging Network (QIN) benchmarks tools for clinical inclusion. 3) The joint roles QIN and QIBA will play in future quantitative imaging efforts.

RC125C Clinical Trials Perspective

Participants
Lawrence H. Schwartz, MD, New York, NY (*Presenter*) Nothing to Disclose

RC127

Patient-centered Imaging: Research, Dissemination and Practice

Sunday, Dec. 1 2:00PM - 3:30PM Room: S502AB

HP RS

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Ruth C. Carlos, MD, MS, Ann Arbor, MI (*Moderator*) Editor, Journal of the American College of Radiology; Support, Harvey L. Neiman Health Policy Institute; In-kind support, Reed Elsevier;

Sub-Events

RC127A Patient Engagement and Comparative Effectiveness Research in Imaging

Participants
Lucy B. Spalluto, MD, Nashville, TN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

lucy.b.spalluto@vumc.org

LEARNING OBJECTIVES

1) Summarize the state of comparative effectiveness research (CER) in imaging. 2) Review concepts of implementation science in imaging. 3) Discuss patient engagement in imaging CER.

RC127B Patient-centered Research in Imaging Care Delivery

Participants
Hanna M. Zafar, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Ilana F. Gareen, PhD, Providence, RI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Illustrate patient-centered research in care delivery using contemporary examples.

RC127C Emerging Topics in Patient-centered Research and Dissemination

Participants
Sheetal M. Kircher, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Ruth C. Carlos, MD, MS, Ann Arbor, MI (*Presenter*) Editor, Journal of the American College of Radiology; Support, Harvey L. Neiman Health Policy Institute; In-kind support, Reed Elsevier;

LEARNING OBJECTIVES

1) Introduce concepts of financial burden of care. 2) Understand the arguments posed for researchers supplying their raw data as a pre-requisite of publication. 3) Familiarize themselves with how medical journals are dealing with patient demands for greater access to and clarity of research findings.

RC129

MRI O-RADS (Interactive Session)

Sunday, Dec. 1 2:00PM - 3:30PM Room: N227B

GU MR OB

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Sub-Events

RC129A Overview and O-RADS 0-1

Participants
Caroline Reinhold, MD, MSc, Montreal, QC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To introduce MRI O-RADS (Ovarian-Adnexal Reporting and Data Systems) 2) To review the MRI O-RADS governing concepts. 3) To know the main terms for O-RADS MRI scores 0 and 1. 4) To understand the application of O-RADS MRI scores 0 and 1 to adnexal masses and the associated risk of malignancy. 5) To recognize O-RADS MRI score 1 lesions by review of cases.

RC129B O-RADS 2

Participants
Evan S. Siegelman, MD, Media, PA (*Presenter*) Advisory Board, Spreemo Health; Consultant, BioClinica, Inc; Consultant, ICON plc; Consultant, inviCRO, LLC

For information about this presentation, contact:

evan.siegelman@uphs.upenn.edu

LEARNING OBJECTIVES

1) Describe the MR terms that characterize adnexal lesions that are almost certainly benign (O-RADS 2). 2) Identify those MR imaging features that would upgrade an adnexal lesion to a higher O-RADS category. 3) Illustrate MR imaging examples of O-RADS 2 lesion such as endometrioma, cystadenoma, mature cystic teratoma, hydrosalpinx and peritoneal inclusion cyst.

RC129C O-RADS 3

Participants
Isabelle Thomassin-Naggara, MD, Paris, France (*Presenter*) Researcher, General Electric Company; Research funded, General Electric Company; Researcher, Canon Medical Systems Corporation; Research funded, Canon Medical Systems Corporation; Research funded, Hologic, Inc; Research funded, Siemens AG; Research funded, Guerbet SA

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LEARNING OBJECTIVES

1) To combine all useful MR features to characterize indeterminate adnexal masses. 2) To describe how to perform DCE MR analysis on solid tissue. 3) To identify how lesions should be classified O-RADS 3. 4) To specify which adnexal lesions will be rated O-RADS 3

RC129D O-RADS 4-5

Participants
Andrea G. Rockall, FRCR,MRCP, London, United Kingdom (*Presenter*) Speaker and Chairman, Guerbet SA

LEARNING OBJECTIVES

1) To know the main terms for O-RADS MR score 4 and 5. 2) To be familiar with the application of O-RADS MR score 4 and 5 to adnexal masses. 3) To recognise O-RADS MR score 4 and 5 lesions by review of cases.

ABSTRACT

The preponderant contribution of MRI in adnexal mass evaluation is its specificity because it provides confident diagnosis of many benign adnexal lesions A standardization of the MR reporting may allow a tailored, patient-centered approach, allowing avoidance of over-extensive surgery and/or fertility preservation where appropriate, whilst ensuring early detection of lesions with high likelihood of malignancy. O-RADS classification is accurate and based on 5 categories related to the rik of malignancy. An adnexal lesion with a solid tissue that enhances according a time intensity curve type 2 or 3 or which is associated with peritoneal implants should be categorized O-RADS 4 or 5. A lesion classified O-RADS 5 has a risk of malignangy higher than 95% and must be referred to a gynecological oncologist

RC129E Case Review

Participants
Elizabeth A. Sadowski, MD, Madison, WI (*Presenter*) Nothing to Disclose

Caroline Reinhold, MD, MSc, Montreal, QC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

esadowski@uwhealth.org

LEARNING OBJECTIVES

1) Understand the basic sequences necessary for characterizing adnexal lesions. 2) Classify adnexal masses using the ACR ORADS MRI system, based on their signal characteristics and enhancement patterns. 3) Assign an ACR ORAD MRI risk score based on the MRI appearance of an adnexal lesion and clinical information.

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RC131

Tumor Ablation Beyond the Liver: Practical Techniques for Success (Hands-on)

Sunday, Dec. 1 2:00PM - 3:30PM Room: N226

GI IR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Debra A. Gervais, MD, Boston, MA (*Presenter*) Nothing to Disclose
Muneeb Ahmed, MD, Boston, MA (*Presenter*) Research Grant, General Electric Company Stockholder, Agile Devices, Inc Scientific Advisory Board, Agile Devices, Inc
Terrance T. Healey, MD, North Scituate, RI (*Presenter*) Nothing to Disclose
Anil N. Kurup, MD, Rochester, MN (*Presenter*) Research Grant, Galil Medical Ltd; Research Grant, EDDA Technology, Inc; Royalties, Wolters Kluwer nv

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Describe indications for tumor ablation in extrahepatic sites. 2) Describe approaches and techniques to help prevent and manage organ specific complications. 3) Review results of tumor ablation in the lung, kidney, and bone.

ABSTRACT

Pulmonary malignancies, and specifically lung cancer, are a leading cause of death worldwide. Utilization of best current therapies results in an overall five-year relative survival rate for all stages combined to be only 15%, necessitating the use of alternative therapies. Image-guided ablation of lung malignancies is a revolutionary concept whose clinical applications are just beginning to be developed. It has some advantages over traditional radiotherapy and chemotherapy. Its safety profile is similar to percutaneous image guided lung biopsy. Almost all image-guided ablative procedures can be performed in an outpatient setting, mostly with conscious sedation. Multiple applications can be performed without any additional risks. Contraindications are few and include uncontrollable bleeding diathesis and recent use of anticoagulants. Image-guided ablation of lung malignancies is performed with two basic rationales. In the first group it is used with an intention of achieving definitive therapy. These are patients who are not candidates for surgery because of co-morbid medical contraindications to surgery, like poor cardiopulmonary reserve or patients refusing to undergo operation. This cohort could potentially derive significant benefit form a minimally invasive alternative therapy. In the second group it is used as a palliative measure as follows: (a) to achieve tumor reduction before chemotherapy (b) to palliate local symptoms related to aggressive tumor growth, such as chest pain, chest wall pain or dyspnea (c) hematogenous painful bony metastatic disease (d) tumor recurrence in patients who are not suitable for repeat radiation therapy or surgery Image-guided ablation is expanding treatment options for the local control of non-small cell lung cancer and metastatic disease. Skeletal metastases are extremely common and may be treated for palliation of pain or local control. Clinically significant, durable pain relief occurs in 75-100% of patients treated for this reason. Local control rates in bone/extravisceral soft tissue vary, and most series report rates of 70-98%. Patients selected for palliation of pain should have moderate-severe pain and a targetable, corresponding lesion. Lesions should be treatable with attention to critical structures, especially major nerves. Care should be used when placing probes in the constrained environment of intact bone. Cement should be added in weight-bearing regions.

RC132

Show Me the Money: Financial Outlook of Radiology

Sunday, Dec. 1 2:00PM - 3:30PM Room: N228

HP LM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.00

Participants
Yoshimi Anzai, MD, Salt Lake City, UT (*Moderator*) Nothing to Disclose

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Sub-Events

RC132A Financial Outlook of Large Academic Department

Participants
James A. Brink, MD, Boston, MA (*Presenter*) Board of Directors, Accumen, Inc

LEARNING OBJECTIVES

1) To understand the key drivers of financial performance in a large academic radiology department. 2) To consider how various factors impact revenue cycle and expense management in academic radiology departments. 3) To explore various scenarios that may affect the financial outlook of academic radiology.

RC132B Financial Outlook of Large Private Practice

Participants
Gregory N. Nicola, MD, River Edge, NJ (*Presenter*) Founder, N2 Health Insights; Consultant, CMO Neutigers

For information about this presentation, contact:

gnnicola@yahoo.com

LEARNING OBJECTIVES

1) Explore common financial stressors on large private radiology practices. 2) Review operational approaches to maximize revenue while maintaining quality. 3) Discuss risk management strategies for changes in payment methodology.

RC132C Financial Outlook of Radiology from International Perspective

Participants
Harriet C. Thoeny, MD, Fribourg, Switzerland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand diversity of healthcare systems in Europe including pricing and reimbursement strategies. 2) To appreciate different scenarios of radiology practice in Europe. 3) To provide an overview of trends in radiology reimbursement and volume in selected European countries.

RC150

MR Imaging-guided Breast Biopsy (Hands-on)

Sunday, Dec. 1 2:00PM - 3:30PM Room: E260

BR MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Amy L. Kerger, DO, Plain City, OH (*Presenter*) Nothing to Disclose
Kirti M. Kulkarni, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Wendi A. Owen, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Gary J. Whitman, MD, Houston, TX (*Presenter*) Nothing to Disclose
Mai A. Elezaby, MD, Madison, WI (*Presenter*) Research Grant, Exact Sciences Corporation
Amado B. del Rosario, DO, Mesa , AZ (*Presenter*) Nothing to Disclose
Mitra Noroozian, MD, Ann Arbor, MI (*Presenter*) Institutional Grant, General Electric Company; Investigator, General Electric Company
Anika N. Watson, MD, Atlanta, GA (*Presenter*) Nothing to Disclose
Lara D. Richmond, MD, Toronto, ON (*Presenter*) Nothing to Disclose
Nikki S. Ariaratnam, MD, Moorestown, NJ (*Presenter*) Consultant, Cleerly, Inc
Clayton R. Taylor, MD, Upper Arlington, OH (*Presenter*) Nothing to Disclose
Rifat A. Wahab, DO, Cincinnati, OH (*Presenter*) Nothing to Disclose
Laurie R. Margolies, MD, New York, NY (*Presenter*) Research Consultant, FUJIFILM Holdings Corporation; Research Consultant, Imago Corporation
Vandana M. Dialani, MD, Boston, MA (*Presenter*) Nothing to Disclose
Esther N. Udoji, MD, Birmingham, AL (*Presenter*) Nothing to Disclose
Jill J. Schieda, MD, Avon Lake, OH (*Presenter*) Nothing to Disclose
Su-Ju Lee, MD, Cincinnati, OH (*Presenter*) Spouse, Stockholder, General Electric Company; Spouse, Stockholder, Siemens AG
Elsa M. Arribas, MD, Houston, TX (*Presenter*) Scientific Advisory Board, Volumetric Biotechnologies, Inc; Stockholder, Volumetric Biotechnologies, Inc
Karen A. Lee, MD, New York, NY (*Presenter*) Nothing to Disclose
Ami D. Shah, MD, New York, NY (*Presenter*) Nothing to Disclose
Katharine D. Maglione, MD, New York, NY (*Presenter*) Nothing to Disclose
Wade C. Hedegard, MD, Brighton, NY (*Presenter*) Nothing to Disclose
Manisha Bahl, MD,MPH, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Explain why MR-guided breast biopsy is needed for patient care. 2) Identify relative and absolute contraindications to MR-guided breast biopsy. 3) Describe criteria for MR-guided breast biopsy patient selection. 4) Debate risks and benefits of pre-biopsy targeted ultrasound for suspicious MRI findings. 5) Understand the basic MR-guided biopsy procedure, protocol and requirements for appropriate coil, needle and approach selection. 6) Manage patients before, during and after MR-guided breast biopsy. 7) Define the benefits and limitations of MR-guided vacuum assisted breast biopsy. 8) How to problem shoot complicated cases due to lesion location, patient anatomy, etc.

ABSTRACT

This course is intended to provide basic didactic instruction and hands-on experience for MR-guided breast biopsy. Because of the established role of breast MRI in the evaluation of breast cancer through screening and staging, there is a proven need for MR-guided biopsy of the abnormalities that can only be identified at MRI. This course will be devoted to the understanding and identification of: 1) appropriate patient selection 2) optimal positioning for biopsy 3) target selection and confirmation 4) various biopsy technologies and techniques 5) potential problems and pitfalls and 6) practice audits. Participants will spend 30 minutes in didactic instruction followed by 60 minutes practicing MR-guided biopsy using provided phantoms. Various combinations of full size state-of-the-art breast MRI coils, biopsy localization equipment and needles from multiple different vendors will be available for hands-on practice. Some stations will have monitors loaded with targeting software. Expert breast imagers from around the world will be at each of 10 stations to provide live coaching, tips, techniques and advice.

Active Handout:Amy L. Kerger

http://abstract.rsna.org/uploads/2019/6005779/Active RC150.pdf

RC152

Dynamic Musculoskeletal US: Clicks and Clunks of the Lower Extremity (Hands-on)

Sunday, Dec. 1 2:00PM - 3:30PM Room: E264

MK US

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Viviane Khoury, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Jon A. Jacobson, MD, Ann Arbor, MI (*Presenter*) Research Consultant, BioClinica, Inc; Advisory Board, Koninklijke Philips NV; Royalties, Reed Elsevier
David P. Fessell, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Ghiyath Habra, MD, Troy, MI (*Presenter*) Nothing to Disclose
Joseph H. Introcaso, MD, Neenah, WI (*Presenter*) Nothing to Disclose
Kenneth S. Lee, MD, Madison, WI (*Presenter*) Grant, General Electric Company; Grant, National Basketball Association; Grant, Johnson & Johnson; Research support, SuperSonic Imagine; Royalties, Reed Elsevier
Humberto G. Rosas, MD, Madison, WI (*Presenter*) Nothing to Disclose
Marnix T. van Holsbeeck, MD, Detroit, MI (*Presenter*) Stockholder, Koninklijke Philips NV; Stockholder, General Electric Company; Stockholder, MedEd3D;
Mark Cresswell, MBBCh, Vancouver, BC (*Presenter*) Consultant, Koninklijke Philips NV
J. Antonio Bouffard, MD, Bloomfield Hills, MI (*Presenter*) Nothing to Disclose
Joseph G. Craig, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Robert R. Lopez, MD, Cornelius, NC (*Presenter*) Nothing to Disclose
Girish Gandikota, MBBS , Ann Arbor, MI (*Presenter*) Nothing to Disclose
Marcos L. Sampaio, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Andrew J. Grainger, MD, Leeds, United Kingdom (*Presenter*) Consultant, Levicept Ltd; Director, The LivingCare Group;
Philippe A. Peetrons, MD, Brussels, Belgium (*Presenter*) Research Consultant, Canon Medical Systems Corporation
Carlo Martinoli, MD, Genova, Italy (*Presenter*) Speaker, Koninklijke Philips NV; Speaker, Canon Medical Systems Corporation; Speaker, Novonordisk Pharmaceuticals; Speaker, Pfizer Inc; Speaker, Novartis AG; Speaker, Swedish Orphan Biovitrum AB
Etienne Cardinal, MD, Montreal, QC (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Identify anatomic structures which can impinge or move abnormally in the lower extremity causing pain during normal range of motion. 2) Describe the ultrasound anatomy and scanning technique for a dynamic examination of these lesions. 3) Position patients optimally for the dynamic evaluation of the upper extremity respecting ergonomics.

ABSTRACT

This course will demonstrate standardized techniques of performing the dynamic examination of hip and ankle lesions that are only or best demonstrated dynamically. These include the snapping hip, peroneal tendon subluxation/dislocation, flexor hallucis longus impingement, and ankle ligament instability. In the first portion of the course, probe positioning will be demonstrated on a model patient with overhead projection during live scanning. In the second portion of the course, an international group of expert radiologists will assist participants in learning positioning and scanning of hip and ankle joint lesions described. An emphasis on dynamic maneuvers and ergonomic documentation of tissue dynamics will be taught. Participants will be encouraged to directly scan model patients.

RC153

Using Imaging Informatics to Enable Patient Experience Improvements in Radiology

Sunday, Dec. 1 2:00PM - 3:30PM Room: S406B

IN LM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Ramin Khorasani, MD, Roxbury Crossing, MA (*Moderator*) Nothing to Disclose

Sub-Events

RC153A Patient Experience in Radiology: The Case for Urgent Action

Participants
Ramin Khorasani, MD, Roxbury Crossing, MA (*Presenter*) Nothing to Disclose

RC153B Patient-centered Imaging Informatics Innovations

Participants
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Presenter*) Speaker, RadPartners AI; Speaker, AIMed Radiology

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LEARNING OBJECTIVES

1) Discuss how imaging informatics can be used to design innovations that help patients to better understand their radiology reports as well as to more effectively connect directly with the radiologists caring for them or their family members. 2) Identify challenges that patients face in navigating their care in radiology that could be addressed by informatics solutions.

RC153C Using Patient Experience Survey Results to Motivate Change

Participants
Neena Kapoor, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn how IT tools can help analyze patient experience comments to identify targets for improvement initiatives.

RC153D Patient Experience: Numbers, Culture, or ?

Participants
Keith D. Hentel, MD, MS, Briarcliff, NY (*Presenter*) Nothing to Disclose

RC153E Patient Challenges and Wish List for Imaging Informatics

Participants
Andrea K. Borondy Kitts, MPH,MS, South Glastonbury, CT (*Presenter*) Stockholder, Abbott Laboratories; Stockholder, AbbVie Inc; Stockholder, F. Hoffmann-La Roche Ltd; Stockholder, Johnson & Johnson; Officer, Prosumer Health; Investor, Prosumer Health; Editor, JACR; Faculty, Medtronic plc; Research funded, Astra Zeneca; ;

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LEARNING OBJECTIVES

1) Help radiologists assess the challenges and barriers faced by patients in finding information about imaging tests and procedures on-line, in accessing and understanding radiologist reports on patient portals, and in understanding, arranging for, and committing to, appropriate follow-up. 2) Provide suggestions for interventions for radiologists and radiology practices to use to help patients find and understand information on appropriate imaging tests for their health/medical situation, find and understand their radiologist report, and understand and arrange for appropriate follow-up.

Active Handout:Andrea K. Borondy Kitts

http://abstract.rsna.org/uploads/2019/18024154/Active RC153E.pdf

Active Handout:Andrea K. Borondy Kitts

http://abstract.rsna.org/uploads/2019/18024154/Active RC153E.pdf

RC154

Cinematic Rendering: Principles, Pearls, and Clinical Applications

Sunday, Dec. 1 2:00PM - 3:30PM Room: E352

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Elliot K. Fishman, MD, Owings Mills, MD (*Moderator*) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company; Co-founder, HipGraphics, Inc
Steven P. Rowe, MD, PhD , Baldwin, MD (*Presenter*) Research funded, Progenics Pharmaceuticals, Inc
Elliot K. Fishman, MD, Owings Mills, MD (*Presenter*) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company; Co-founder, HipGraphics, Inc
Linda C. Chu, MD, Lutherville, MD (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the principles of cinematic rendering and how it differs from classic 3D techniques like volume rendering and maximum intensity projection (MIP) techniques. 2) Understand the potential role of cinematic rendering in applications ranging from oncology to trauma to vascular imaging. 3) Understand the role of cinematic rendering in specific applications in the pancreas, liver, kidneys and cardiovascular imaging. 4) understand how to implement cinematic rendering in your practice. 5) understand the pitfalls of creating images with cinematic rendering and how to help minimize them.

ABSTRACT

Cinematic Rendering (CR) represents an advance in volume visualization with a high fidelity display of CT data. The technique has evolved with the introduction of faster GPU's at a lower cost and these GPU;s being used for medical imaging. In this refresher course we will discuss the basic principles of Cinematic Rendering and its advantages over classic volume rendering (VR) and maximum intensity projection technique (MIP). Case studies illustrating the advantages and disadvantages of each techniques will be discussed and illustrated. We will also discuss the range of current clinical applications focusing on oncology (pancreas, liver, kidney, small bowel) musculoskeletal trauma, cardiothoracic imaging (including cardiac imaging) and vascular imaging.

RCA12

Hands-on Artificial Intelligence for Non-coders: How is an Intracranial Hemorrhage Detection Algorithm Created? (Hands-on)

Sunday, Dec. 1 2:00PM - 3:30PM Room: S401AB

AI IN NR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Luciano M. Prevedello, MD, MPH, Dublin, OH (*Moderator*) Nothing to Disclose
Luciano M. Prevedello, MD, MPH, Dublin, OH (*Presenter*) Nothing to Disclose
Felipe C. Kitamura, MD, MSC, Sao Paulo, Brazil (*Presenter*) Consultant, MD.ai, Inc
Igor R. Dos Santos, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose
Ian Pan, MA , Providence, RI (*Presenter*) Consultant, MD.ai

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LEARNING OBJECTIVES

1) Understand some of the important steps in the development of Deep Learning algorithms in Radiology including: a) Data Curation: How to organize the dataset into training/validation/test sets and create appropriate classes and labels; b) Training: Important considerations related to algorithm development including image pre-processing and data-augmentation; c) Inference: Understand how to measure algorithm performance.

ABSTRACT

The resurgence of neural networks, and more specifically deep learning, applied to computer vision tasks has been revolutionizing many industry verticles. The technique will likely positively impact Medical Imaging and augment radiologists capabilities to provide excellent patient care. Having an intuition of how these techniques work will be key to interpret its results. In this session, attendees will learn, through practical hands-on examples, how current state-of-the-art artificial intelligence algorithms are created and how they can be used to enhance workflow, augment image interpretation and ultimately improve patient care.

RCC12

Ethics of AI in Radiology: Summary of the European and North American Multisociety Statement

Sunday, Dec. 1 2:00PM - 3:30PM Room: E451A

AI IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
J. R. Geis, MD, Fort Collins, CO (*Moderator*) Nothing to Disclose
Judy W. Gichoya, MBChB,MS, Portland, OR (*Presenter*) Nothing to Disclose
Elmar C. Kotter, MD, MSc, Freiburg, Germany (*Presenter*) Editorial Advisory Board, Thieme Medical Publishers, Inc; Clinical Advisory Board, Agfa Healthcare

LEARNING OBJECTIVES

1) Realize that AI will make clinical and workflow decisions in radiology. While this will mature into a reliable and robust infrastructure, currently no one has meaningful experience using such machines for patient care at scale. This gives rise to considerable potential for errors with high consequences. 2) Realize that your radiology data are extremely valuable for commercial purposes. Understand how to control access to those data, and to make your enterprise aware. 3) Recognize different types of bias in radiology data. 4) Appreciate ethical issues for machine learning and AI in radiology. 5) Understand unique aspects of transparency, fairness, and privacy when using AI in radiology.

ABSTRACT

It is challenging to use decision-making AI machines in radiology situations that previously could only be done by humans. AI offers great promise but comes with numerous potential pitfalls, and is inevitably biased to some degree. Radiologists have a duty to understand the benefits and risks of AI agents they use, to alert patients and stakeholders to potential pitfalls as appropriate, and to monitor AI products to guard against harm. While this will undoubtedly mature into a reliable and robust infrastructure, currently we lack meaningful experience using such machines for patient care at scale. This gives rise to considerable potential for errors with high consequences. Because developing AI driven machines today requires massive amounts of well labeled radiology data, the value of those data is skyrocketing and the drive to provide commercial access to radiology data will become overwhelming. Currently how to allow, manage, and contract for that data access is evolving at a rate which outstrips our current knowledge or abilities. We are at risk of making expensive and calamitous mistakes with radiology data. In addition to the significant good which will come from using these data to make better predictions and improve patient health, the opportunity unquestionably exists to obtain incredibly significant additional income by using these data in unethical ways which may harm patients, other cohorts, or the common good. Limiting radiology AI to ethical uses means leaving a massive amount of money on the table. One of our greatest challenges is how to thwart those who will attempt to acquire this value. Patients, radiologists, and other cohorts in the radiology community are at risk of being engulfed by digital surveillance and categorized and manipulated by intelligent and autonomous machines. AI has dramatically altered our perception of radiology examinations and associated data --- their value, how to use them and how they may be misused. As much as understanding AI, radiologists have a moral duty both to understand their data, and to use the data they collect to improve the common good, extract more information about patients and their diseases, and improve the practice of radiology.

SPAI13

RSNA AI Deep Learning Lab: Data Science: Data Wrangling

Sunday, Dec. 1 3:00PM - 4:30PM Room: AI Showcase, North Building, Level 2, Booth 10342

AI **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants

Katherine P. Andriole, PhD, Chestnut Hill, MA (*Presenter*) Research funded, NVIDIA Corporation; Research funded, General Electric Company; Research funded, Nuance Communications, Inc; ; ; ;

Special Information

In order to get the best experience for this session, it is highly recommended that attendees bring a laptop with a keyboard, a decent-sized screen, and the latest version of Google Chrome. Additionally, it is recommended that attendees have a basic knowledge of deep learning programming and some experience running a Google CoLab notebook. Having a Gmail account is also helpful. Here are instructions for creating and deleting a Gmail account.

ABSTRACT

This session will include a deeper dive into data preparation and analysis tasks required to obtain the best results from your deep learning system. It will include a discussion of data cohort makeup, different options for representing the data, how to normalize the data, particularly image data, the various options for data labeling / image annotation and the benefits of each option. Model performance metrics will also be examined. We will discuss the 'after training' aspects of deep learning including validation and testing to ensure that the results are robust and reliable.

Printed on: 10/29/20

VSIO12

Interventional Oncology Series: Novel Targets for Interventional Oncologists

Sunday, Dec. 1 3:15PM - 5:15PM Room: S405AB

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AMA PRA Category 1 Credits ™: 2.00
ARRT Category A+ Credits: 2.25

FDA Discussions may include off-label uses.

Participants
Luigi Solbiati, MD, Pieve Emanuele (milano), Italy (*Moderator*) Nothing to Disclose

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LEARNING OBJECTIVES

1) List more recent, non conventional applications of image-guided percutaneous ablation for thyroid, parathyroids, adrenals, prostate, breast and pancreas. 2) Learn technological and technical aspects and clinical indications of these mini-invasive treatments. 3) Identify how and in which clinical situations these recent ablative treatments can replace conventional therapies.

Sub-Events

VSIO12-01 Different Ablative Techniques for Benign Thyroid Nodules

Sunday, Dec. 1 3:15PM - 3:30PM Room: S405AB

Participants
Giovanni Mauri, MD, Milan, Italy (*Presenter*) Consultant, Elesta Srl

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LEARNING OBJECTIVES

1) Describe and compare various ablative techniques available for the treatment of benign thyroid nodules. 2) Recommend appropriate indication for various ablative techniques of benign thyroid nodules. 3) Assess clinical results of ablative techniques of benign thyroid nodules.

ABSTRACT

Image-guided ablations are gaining an increasingly important role in the treatment of patients with benign thyroid nodules. Some different techniques have been succesfully applyied in the treatment of benign thyroid nodules, including laser ablation, radiofrequency ablation, microwaves ablation and high intensity focused ultrasound. In this course, the different techniques for ablation of benign thyroid nodules will be presented and compared. Furthermore, clinical indications and results of image guided ablation of benign thyroid nodules will be presented and discussed.

VSIO12-02 Percutaneous Ablation for Thyroid Malignancies

Sunday, Dec. 1 3:30PM - 3:45PM Room: S405AB

Participants
Ji-hoon Kim, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

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jihnkim@gmail.com

LEARNING OBJECTIVES

1) To understand the current issues with regard to the management of primary and recurrent thyroid cancers. 2) To learn outcome and complication of percutaneous ablation for primary and recurrent thyroid cancers. 3) To suggest indication of percutaneous ablation for primary and recurrent thyroid cancers over other treatment modalities.

VSIO12-04 Percutaneous Ablation of Parathyroid Adenoma

Sunday, Dec. 1 3:55PM - 4:10PM Room: S405AB

Participants
Luigi Solbiati, MD, Pieve Emanuele (milano), Italy (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To learn what instrumentation can be used for ablation of parathyroid adenomas and how to use them. 2) To understand what complications can be caused by ablation of parathyroid adenomas and what procedures can be followed to avoid them. 3) To learn indications and contraindications of thermal ablation of parathyroid adenomas.

VSIO12-05 Percutaneous Ablation of Adrenal Tumors and Retroperitoneal Adenopathies

Sunday, Dec. 1 4:10PM - 4:25PM Room: S405AB

Participants
Paul B. Shyn, MD, Boston, MA (*Presenter*) Research Grant, Siemens AG

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LEARNING OBJECTIVES

1) Assess the appropriateness of clinical indications for adrenal and retroperitoneal tumor ablation. 2) Compare the advantages and disadvantages of various adrenal and retroperitoneal tumor ablation technologies. 3) Appraise and manage the risks of adrenal and retroperitoneal tumor ablation.

VSIO12-06 Percutaneous Image-guided Prostate Interventions

Sunday, Dec. 1 4:25PM - 4:40PM Room: S405AB

Participants
Eric M. Walser, MD, Galveston, TX (*Presenter*) Nothing to Disclose

VSIO12-07 Percutaneous Image-guided Ablation of Breast Cancer

Sunday, Dec. 1 4:40PM - 4:55PM Room: S405AB

Participants
Jean Palussiere, MD, Bordeaux, France (*Presenter*) Speaker, Boston Scientific Corporation

LEARNING OBJECTIVES

1) To describe the different methods of thermal ablation applied to breast cancer. 2) To develop specificities of breast tissue following heating, freezing. 3) To specify technical skills with protection measures of vulnerable structures. 4) To define the best indications : for which patients ? which tumor ? (size, location, type). 5) To list the limits, indications and contraindications. 6) To identify which techniques are under development and might increase indications.

VSIO12-08 Percutaneous Ablation of Pancreatic Adenocarcinoma

Sunday, Dec. 1 4:55PM - 5:10PM Room: S405AB

Participants
Giovanni Mauri, MD, Milan, Italy (*Presenter*) Consultant, Elesta Srl

VSIO12-09 Panel Discussion

Sunday, Dec. 1 5:10PM - 5:15PM Room: S405AB

PS12

Sunday Afternoon Plenary Session

Sunday, Dec. 1 4:00PM - 5:45PM Room: Arie Crown Theater

BR CH GI IR MK NR NM PD

AMA PRA Category 1 Credits ™: 1.75
ARRT Category A+ Credit: 1.75

Participants
Valerie P. Jackson, MD, Tucson, AZ (*Presenter*) Nothing to Disclose

Sub-Events

PS12A Report of the RSNA Research and Education Foundation

Participants
Thomas M. Grist, MD, Madison, WI (*Presenter*) Institutional research support, General Electric Company; Institutional research support, Bracco Group; Institutional research support, Siemens AG; Institutional research support, Hologic, Inc; Institutional research support, McKesson Corporation; Stockholder, Elucent; Stockholder, HistoSonics, Inc;

PS12B Image Interpretation Session

Participants
Neil M. Rofsky, MD, Dallas, TX (*Moderator*) Advisory Board, InSightec Ltd; CME & Education Steering Committee, Medscape, LLC
Laura W. Bancroft, MD, Venice, FL (*Presenter*) Nothing to Disclose
Yoshimi Anzai, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose
Robert D. Boutin, MD, Davis, CA (*Presenter*) Nothing to Disclose
Govind B. Chavhan, MD, Toronto, ON (*Presenter*) Speaker, Bayer AG
Philippe A. Grenier, MD, Saint Cloud, France (*Presenter*) Nothing to Disclose
S. Nahum Goldberg, MD, Efrat, Israel (*Presenter*) Consultant, AngioDynamics, Inc; Consultant, Cosman Medical, Inc; Consultant, XACT Robotics;
Nicole M. Hindman, MD, New York, NY (*Presenter*) Nothing to Disclose
Jessica W. Leung, MD, Houston, TX (*Presenter*) Scientific Advisory Board, Subtle Medical
Don C. Yoo, MD, Lexington, MA (*Presenter*) Consultant, inviCRO, LLC

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LEARNING OBJECTIVES

1) Identify key abnormal findings on radiologic studies that are critical to making a specific diagnosis. 2) Construct a logical list of differential diagnoses based on the radiologic findings, focusing on the most probable differential diagnoses. 3) Determine which, if any, additional radiologic studies or procedures are needed in order to make a specific final diagnosis. 4) Choose the most likely diagnosis based on the clinical and the radiologic information.

RCA13

Hands-on Artificial Intelligence for Non-coders: Object Localization and Image Segmentation (Hands-on)

Sunday, Dec. 1 4:00PM - 5:30PM Room: S401AB

AI IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Peter Chang, MD, San Francisco, CA (*Moderator*) Nothing to Disclose
Peter Chang, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Simukayi Mutasa, MD, New York, NY (*Presenter*) Nothing to Disclose
Jae Ho Sohn, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Michelle Bardis, MS, Orange, CA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Identify the difference between image classification, object localization and image segmentation. 2) Explain the steps required in data collection and annotation for object localization and image segmentation tasks. 3) Assess the benefits and drawbacks of utilizing object detection and image segmentation methods as opposed to object classification. 4) Examine the current state of the art base neural network architectures for object detection and image segmentation at a qualitative level. 5) Run a previously trained object detection and segmentation network for localizing intracranial hemorrhage.

RCC13

Creating Publicly Accessible Radiology Imaging Resources for Machine Learning and AI

Sunday, Dec. 1 4:00PM - 5:30PM Room: E353C

AI IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
John B. Freymann, Rockville, MD (*Moderator*) Nothing to Disclose
Laura P. Coombs, PhD, Reston, VA (*Presenter*) Nothing to Disclose
John B. Freymann, Rockville, MD (*Presenter*) Nothing to Disclose
Jayashree Kalpathy-Cramer, MS, PhD, Portland, OR (*Presenter*) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd;
George L. Shih, MD, New York, NY (*Presenter*) Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;
Laila M. Poisson, Detroit, MI (*Presenter*) Nothing to Disclose
Arie Meir, PhD, Mountain View, CA (*Presenter*) Employee, Alphabet Inc

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LEARNING OBJECTIVES

Learn about practical challenges of data preparation (e.g. de-identification) and possible venues for hosting public data sets Learn techniques for image pre-processing to improve reproducibility and generalizability Learn about tools for creating 'ground truth' labeling of imaging data sets Learn statistical approaches to properly create training & testing cohort

ABSTRACT

Well-curated and annotated imaging data sets have been recognized as a prerequisite to the development of computer-aided detection and diagnostic algorithms, but with the new advances in machine learning and artificial intelligence, special attention to how these data sets are prepared is even more critical. This session will provide attendees with an opportunity to learn from leaders in the fields of radiology and AI about their experiences developing and leveraging publicly-accessible data resources for AI. Participants will learn about practical challenges such as de-identification, image pre-processing steps to improve reproducibility, tools & techniques for creating 'ground truth' labeling, and statistical approaches to properly create training & testing cohorts.

Active Handout:Laila M Poisson

http://abstract.rsna.org/uploads/2019/19003018/Active RCC13.pdf

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