103rd Scientific Assembly and Annual Meeting

November 26 to December 1 McCormick Place, Chicago





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103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



PS10

Opening Session

Sunday, Nov. 26 8:30AM - 10:15AM Room: Arie Crown Theater

ОТ

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

Participants

Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc; Melissa C. Martin, MS, Signal Hill, CA (*Presenter*) Nothing to Disclose Vanessa V. Wear, MD, Chicago, IL (*Presenter*) Nothing to Disclose

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Sub-Events

PS10A Presentation of the Outstanding Educator Award

Participants

Dorothy I. Bulas, MD, Washington, DC (Recipient) Nothing to Disclose

PS10B Presentation of the Outstanding Researcher Award

Participants

Mitchell D. Schnall, MD, PhD, Philadelphia, PA (Recipient) Nothing to Disclose

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PS10C Dedication of the 2017 RSNA Meeting Program to the Memory of Richard L. Baron, MD (1949-2017) and Posthumous Gold Medal Presentation

PS10D President's Address: Is it Time to Reinvent Radiology?

Participants

Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc; David J. Lomas, MD, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose

Abstract

As a global society with more than 54,000 members in 144 countries, the Radiological Society of North America is a powerful force for advancing the science and practice of medical imaging for the benefit of patients worldwide. As president of the RSNA, I am awed by the amazing opportunities that lie ahead in our field. The extraordinary advances in medical imaging technology of the last decades have improved diagnostic medicine so profoundly that most physicians could scarcely imagine taking care of patients without them. In countless ways, these technologies have brought diagnostic clarity to clinical decisions that were previously shrouded in uncertainty. They have provided safe and less expensive alternatives to invasive procedures. Such innovations in medical imaging have often been the product of unique multidisciplinary efforts, harnessing biomedical science with physical science and engineering. The field of radiology can be traced back to a singular discovery and invention by Wilhelm Roentgen 122 years ago and most of the singular advances in our field since then have been the product of invention. A striking aspect of innovation in radiology over the years is that it is usually focused on addressing very practical problems and resulting solutions have often been translated to improve the care of patients with amazing speed. Recent studies have also shown that investments in research in the field of medical imaging have a very high rate of return, including a remarkable rate of new inventions and substantial downstream economic impact. Perhaps the most important opportunity now before us is to reinvent radiology practice to optimize value. In the context of medical imaging, the value of a diagnostic procedure can be considered to be a ratio in which the numerator contains the sum of metrics for diagnostic performance, quality, safety, and service, and the denominator is cost. Extraordinary innovations in medical imaging science and technology over the last decades have steadily advanced the numerator of the value equation. However, as medical delivery systems reorganize to address escalating cost, it seems imperative for the radiology community to show leadership by innovating to maximize the value equation in diagnostic imaging as an alternative to rationing. These efforts will certainly involve the science of medical decision-making and process management. But radiology should also harness the unique multidisciplinary union of biological and physical sciences that created our field in the first place to expand our ability to employ our

most powerful technologies to serve our patients.

PS10E Tomorrow's Radiology

Participants

Roderic I. Pettigrew, PhD, MD, Bethesda, MD (*Presenter*) Nothing to Disclose Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

Abstract

The overarching goal of the healthcare enterprise can be summarized in the two words, Healthy Longevity. The vision is straightforward: to be born healthy, acquire no significant disease, live a long and satisfying life, and when the end of life arrives, to do so without the accompaniment of pain and suffering from disease. Biomedical imaging has and will have a critical role in achieving this dream. Indeed, modern medicine and the medicine of tomorrow is unthinkable without biomedical imaging. Rather we envision an even greater and more integrated role in medical education, research and the practice of medicine. In each of these areas, the advent of virtual reality and augmented reality, where virtual and real images are superimposed and integrated, will catalyze remarkable advances in learning, discovery, skill honing and efficient and precise therapeutic interventions. Considering that imaging has been fundamentally described as the science of obtaining spatially and temporally resolved information across all biological scales, its role is central in realizing the promise of convergence or transdisciplinary science for accelerating advances in medical research. In the practice of medicine, where imaging guides much of the course of patient care, there is considerable promise in achieving increasingly higher-value imaging studies. Dramatic advances in speed of image data acquisition and clever yet scientifically sound methods for data handling, processing efficiency and information extraction will change the routine imaging paradigm to one that is more time efficient with greater diagnostic content. Scans can be much shorter with more targeted protocols, and when full studies are needed, these too will be acquired with rapid complete data sets that will obviate the need for further imaging. Interpretations will take advantage of quantitative data and assessments in which analytical tools integrate information across biological and physical datasets. The integration of genetic encoding, protein expression, metabolic action, tissue physiology with detected image features will characterize tomorrow's radiology. Much of this will be greatly aided by machine and deep learning giving rise to more timely and precise diagnostics and treatment. There is great hope for the synergistic role that machine learning will play, given the considerable investments in this field among academics and industry, and the growing public availability of large and comprehensive data sets. From these should come deeper insights into the mechanisms of disease, and how to detect disease early on, intervene and prevent illness. In radiology, machine learning will help improve imaging performance with technique optimization and efficiency, leverage modern data science by culling important information from the complete datasets, and share collective international expertise in image interpretation and assessment where this would be helpful. As we look toward the goal of Healthy Longevity, the radiology of tomorrow will be central in the transformation of the international medical ecosystem from one centered on disease treatment to one focused on health management.

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PS10F Imaging Innovation in 21st Century Biomedicine: Challenges and Opportunities

Participants

Elias A. Zerhouni, MD, Fort Lauderdale, FL (*Presenter*) Officer, sanofi-aventis Group Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

Abstract

Challenges and opportunities Healthcare challenges are mounting worldwide with unsustainable rising costs. Discovering new ways of lessening the impact of chronic diseases and aging which now contribute about 80 percent of these costs is a core public health challenge. Many acute conditions remain difficult to manage and previously controlled diseases are re-emerging. Recent scientific advances have revealed the enormous complexity of biological systems in health and disease. Numerous molecular tools from small to more complex molecules such as antibodies, proteins or RNAs have been developed to research and treat the specific molecular pathways of many diseases. Key to these efforts will be our ability to better understand the fundamental mechanisms of human diseases, to validate in patients the role and function of targets identified by research efforts and to develop large scale analyses of human genotypes and phenotypes to identify the relevant patient subpopulations. The prospect of intervening before deterioration of function by predicting which patients would most likely benefit from these novel therapeutics is the essence of the concept of PRECISION MEDICINE. The need to unravel the daunting complexity of biological systems and to understand human disease evolution with greater precision is the fundamental challenge for 21st century biomedicine. The imaging sciences have already played and will continue to play a critical and increasingly important role in biomedicine from preclinical to clinical applications as they uniquely enable the precise 3 dimensional localization of biological information and their evolution over time at molecular as well as full body and population scales. Today a major impediment to the development of novel therapeutics is the paucity of validated associative or predictive biomarkers that can inform investigators of the exact short and long term effects of their therapeutics in vivo. In oncology and autoimmune diseases for example we need to better understand the degree and dynamics of infiltration, activation and mobilization of immune cells in response to therapeutic agents at the site of pathology and not only in the blood circulation. Biopsies are useful but suffer from sampling errors and do not provide dynamic information. Recent advances with novel PET and SPECT isotopes with half-lifes consistent with the pharmacokinetics and pharmacodynamics of the multitude of novel therapeutic agents now in development is promising. Recent imaging advances increasingly provide accurate and quantitative estimates of the response of an organ over time as in the evaluation of brain structural changes which could become a critical biomarker for several degenerative brain diseases enabling selection and intervention PRIOR to irreversible loss of function. Another frontier will be the subclassification of disease states through the large scale comparative analyses of large human imaging databases enabling the radiologist to quickly characterize the stage and type of pathology relative to a large reference population database aided by artificial intelligence algorithms. This revolutionary step could provide medicine the ability to objectively classify and quantify diffuse and confounding disease states in multiple organs over time and enable what could be termed the era of PRECISION radiology.

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SPOI11

Oncodiagnosis Panel: Spinal Metastasis

Sunday, Nov. 26 10:45AM - 12:15PM Room: E353C



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

Participants

Nina A. Mayr, MD, Seattle, WA (*Moderator*) Nothing to Disclose Peter C. Gerszten, MD, MPH, Pittsburgh, PA (*Presenter*) Nothing to Disclose Mahmud Mossa-Basha, MD, Seattle, WA (*Presenter*) Nothing to Disclose Simon S. Lo, MD, Seattle, WA (*Presenter*) Research support, Elekta AB ; Sten Myrehaug, MD, FRCPC, Toronto, ON (*Presenter*) Travel support, Ipsen SA; Travel support, Novartis AG; Speaker, Novartis AG

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LEARNING OBJECTIVES

1) To discuss the pre-treatment imaging evaluation of spinal metastases. 2) To discuss the surgical aspects of spinal metastases. 3) To discuss the target delineation for stereotactic body radiotherapy (SBRT) for spinal metastases. 4) To discuss the challenges with post-SBRT radiographic evaluation of response.

ABSTRACT

The spinal column is one of the most common sites for metastatic involvement. Proper imaging evaluation is crucial in guiding appropriate therapy, which includes surgery, radiotherapy, or combined surgery and radiotherapy. Stereotactic body radiotherapy (SBRT) has emerged as one of the standard therapies for spinal metastases and it is either given alone or in combination with stabilization and/ or decompression surgery. Challenges exist with regard to post-SBRT response evaluation.





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SSA01

Breast Imaging (Multimodality Screening and Breast Density)

Sunday, Nov. 26 10:45AM - 12:15PM Room: Arie Crown Theater

BR

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

Participants

Colleen H. Neal, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose Liane E. Philpotts, MD, New Haven, CT (*Moderator*) Consultant, Hologic, Inc

Sub-Events

SSA01-01 Discordant Interpretation of Screen-Detected Cancers Using Tomosynthesis and Independent Double Reading in a Population-Based Mammography Screening Program

Sunday, Nov. 26 10:45AM - 10:55AM Room: Arie Crown Theater

Participants

Per Skaane, MD, PhD, Oslo, Norway (*Presenter*) Equipment support, Hologic, Inc Consultant, Hologic, Inc Support, Hologic, Inc Randi Gullien, RT, Oslo, Norway (*Abstract Co-Author*) Support, Hologic, Inc; Travel support, Hologic, Inc Bjorn Helge Osteras, MSc, Oslo, Norway (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Analyze missed screening cancers (SDC) with tomosynthesis (DBT) using independent double reading in population-based screening

METHOD AND MATERIALS

Trial was approved by Ethical Committee. Participating women signed a written consent. 24,301 women age 50-69 undergoing FFDM+DBT were included. The trial had 4 arms A-D: A=FFDM,B=FFDM+CAD,C=FFDM+DBT, D=syn2D+DBT. Reading was performed in batch mode using a 5-point rating scale. 8 readers participated alternating between reading modes. Scores 1 (neg) and 2-5 (pos) were stored directly into the national screening database. Cases with positive score by at least one reader were discussed at arbitration meeting before final decision for recall. There was automated recording of all reading times directly into the screening database. For purpose of this analysis, mainly the two arms C-D including DBT were analyzed.

RESULTS

230 SDC were diagnosed: 3 cancers in arm A+B only, 172 cancers in both main arms A+B and C+D, and 55 cancers in arm C+D only (detection rate 2D=175 or 7.2/1000 vs. 2D+3D=227 or 9.3/1000, p<0.001). Among SDC in both main arms, discordant rate (cancer missed by one reader) was 50/172 (29%) for arms A-B and 41/172 (24%) for arms C-D. Discordant rate for DBT-only was 30/55 (55%). Discordant cancers for arms C-D among the 172 SDC included spiculated mass or distortion in 17/41 (41%) and in 21/30 (70%) for DBT-only cases. Discordance for microcalc's only was 16/41 (39%) and 2/30 (7%), respectively. Median reading time for exams with negative score by all 4 readers (n=20,106) was: Arm A 25 sec, arm B 28 sec, arm C 62 sec (range 36-170), and arm D 58 sec (range 36-156). For the 55 DBT-only detected cancers, median reading time for TP's in arm C-D was 229 and 217 sec compared with 70 and 59 sec for FN's, respectively. 4/6 (67%) of SDC among the 30 discordant DBT-only cancers with less than 45 sec reading time presented as spiculated mass or distortion. The TP rate (detected cancers among all read) for arms C-D for individual readers varied from 7% to 39%. The radiologist with shortest reading time missed most cancers.

CONCLUSION

Discordant interpretation is a challenge in screening including use of DBT, and subtle cancers presenting as spiculations might easily be missed at DBT using batch reading

CLINICAL RELEVANCE/APPLICATION

Subtle cancers manifesting with spiculations might easily be overlooked. Training and careful reading might reduce number of missed small cancers

SSA01-02 Breast Density Comparison Between Synthesized Versus Full Field Digital Mammography

Sunday, Nov. 26 10:55AM - 11:05AM Room: Arie Crown Theater

Awards Student Travel Stipend Award

Participants Irfanullah Haider, MD, MBA, SALT LAKE CITY, UT (*Presenter*) Nothing to Disclose Matthew B. Morgan, MD, Sandy, UT (*Abstract Co-Author*) Consultant, Reed Elsevier Anna K. McGow, MD, MBA, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Matthew Stein, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Maryam Rezvani, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Nan Hu, PhD,MS, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Laurie L. Fajardo, MD, MBA, Park City, UT (*Abstract Co-Author*) Consultant, Hologic, Inc Scientific Advisory Board, Hologic, Inc Consultant, Koninklijke Philips NV Advisory Board, Koninklijke Philips NV Consultant, Siemens AG Consultant, FUJIFILM Holdings Corporation Advisory Board, Galena Biopharma, Inc Nicole S. Winkler, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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PURPOSE

To evaluate perceptual difference in breast density classification using synthesized mammography (SM) compared to full field digital mammography (FFDM) for screening mammography.

METHOD AND MATERIALS

This institutional review board approved retrospective multi-reader study evaluated breast density on 200 patients who underwent baseline screening mammogram during which both SM and FFDM were obtained from 6/1/2016 through 11/30/2016. Qualitative breast density was independently assigned by 7 readers (blinded to each other) initially viewing FFDM alone. Then, in a separate session, these readers assigned breast density using synthetic views alone on the same 200 patients and were again blinded to each other's assignment. Qualitative density assessment was based on Breast Imaging Reporting and Data Systems (BI-RADS) 5th Edition. Generalized linear mixed effects model (GLMEM) was used to evaluate the association of breast density between SM and FFDM taking into account random variation by controlling for age and breast thickness on breast density classification and readers. Odds ratios (ORs) and their 95% confidence intervals (CIs) were then calculated for these variables.

RESULTS

The OR for denser breast classification in SM versus FFDM was 0.581 (95% CI: 0.460, 0.733; p-value < 0.0001) demonstrating a statistically significant denser breast assignment on SM compared to FFDM per patient across the readers. Raw data analysis shows 81.8% had no change in density assignment between SM and FFDM, 6.3% were higher density in FFDM though 11.9% had a higher density assigned in SM. The OR for compressed breast thickness was 1.26 (p=0.01) reflecting generally lower density in thicker breasts. The OR for age was 1.47 (p-value < 0.001) reflecting higher density BIRADS classification in younger women.

CONCLUSION

SM is associated with a higher qualitative breast density BI-RADS assessment compared to FFDM resulting in a higher likelihood of assigning a greater density classification in SM compared to FFDM.

CLINICAL RELEVANCE/APPLICATION

Synthesized mammography (SM) is increasingly replacing full field digital mammography (FFDM), but its impact on qualitative breast density classification has not been studied. Density assessment is important as it conveys information regarding cancer risk and accuracy of mammography, which may alter decisions about adjunctive imaging, therefore determining whether assessment differs between SM and FFDM is important.

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SSA01-03 The Relationship between Quantitative Breast Density, Age and Cancer Detection Rate in a Large UK Breast Screening Population

Sunday, Nov. 26 11:05AM - 11:15AM Room: Arie Crown Theater

Awards

Student Travel Stipend Award

Participants

Sam Dumonteil, MBBS, FRCR, London, United Kingdom (*Presenter*) Nothing to Disclose Louise S. Wilkinson, MBBCh, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Elizabeth S. Burnside, MD, MPH, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Samantha L. Heller, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Sue Hudson, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Shahrooz Mohammadi, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Quantitative breast density has been proposed as one of the most promising variables to stratify screening strategies; however, little is known about the relationship between density and cancer detection rates (CDR), which we evaluate in a prospectively collected cohort of patients in a UK breast screening program.

METHOD AND MATERIALS

We included 70,435 consecutive screening digital mammograms for women age 47-73 performed between March 2013 and September 2016. We excluded women at high risk as defined by National Health Service Breast Screening Programme (NHSBSP) protocols. Breast density was quantitatively measured using Volpara density software (VolparaSolutions, Edition 5 Wellington, NZ) and categorised by Volpara Density Grade (VDG). We divided our population into three 9 year age groups, 47-55, 56-64 & 65-73 in order to compare CDR in the lowest (VDG 1) and highest (VDG 4) density women stratified by age. Differences in CDR by density group in each tertile were tested using Fisher's exact test with p<0.05 to signify statistical significance.

RESULTS

A total of 70,435 screening mammograms in 63,577 women were included revealing 557 cancers for an overall CDR of 0.8%. In 47-55 year olds, women in the VDG 1 density group had a CDR of 0.16%; women in the VDG 4 density group had a CDR of 0.85%. The difference of 0.69% was statistically significant (p=0.01). In 56-64 year olds, women in the VDG 1 density group had a CDR of 0.63%; women in the VDG 4 density group had a CDR of 0.58%. The difference of 0.04% was not statistically significant (p=0.84). In 65-73 year olds, women in the VDG 1 density group had a CDR of 0.99%; women in the VDG 4 density group had a CDR of 0.24%. The difference of 0.75% was statistically significant (p=0.04).

CONCLUSION

We found an opposite trend between breast density and CDR between the youngest and oldest age groups. Older women with the least dense breasts had a higher CDR than those with the densest breasts while the reverse was true in younger women. The differences in CDR between the densest and least dense women were statistically significant in the youngest and oldest age groups.

CLINICAL RELEVANCE/APPLICATION

The relationship between cancer detection rate and density may vary with age and should be taken into account when stratifying women into different screening strategies based on density.

SSA01-04 Is Two-Dimensional Synthetic Mammography Combined with Tomosynthesis Comparable to Conventional Full-Field Digital Mammography for the Detection of Microcalcifications at Screening?

Sunday, Nov. 26 11:15AM - 11:25AM Room: Arie Crown Theater

Participants

Yi-Chen Lai, MD, Taipei, Taiwan (*Presenter*) Nothing to Disclose Kimberly M. Ray, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Amie Y. Lee, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Jessica H. Hayward, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Rita I. Freimanis, MD, Winston-Salem, NC (*Abstract Co-Author*) Nothing to Disclose Bonnie N. Joe, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Iryna Lobach, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

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kimberly.ray@ucsf.edu

PURPOSE

To compare the performance of two-dimensional synthetic mammography (SM) in combination with digital breast tomosynthesis (DBT) versus conventional full-field-digital mammography (FFDM) in the detection of microcalcifications on screening examinations.

METHOD AND MATERIALS

In this HIPAA-compliant, IRB-approved protocol, a multi-reader (n=4), retrospective observer study was conducted. Seventy-two consecutive screening mammograms performed with FFDM, digital breast tomosynthesis (DBT), and SM, which were recalled for calcifications from 2014-2015, constituted the study dataset. There were 54 benign and 18 malignant calcification cases. Twenty normal control screening mammograms without calcifications were also included. All normal or benign cases were with verified with at least 1-year follow-up and suspicious lesions verified with biopsy. Two anonymized datasets were created, one consisting of FFDM images and another consisting of SM and DBT images. Two readers reviewed each anonymized dataset. Calcification recalls were tabulated. Sensitivity and specificity for calcification detection were calculated and compared for the SM+DBT versus FFDM group. A mixed effects generalized linear model was used to account for correlation between multiple interpretations of the same image.

RESULTS

Reader agreement for FFDM was 82.6% (95%CI, 73.3%-89.7%), Cohen's kappa = 0.733, p<0.001 and for SM+DBT was 79.3% (95%CI, 69.6%-89.1%), Cohen's kappa = 0.677, p<0.001. Overall sensitivities for benign and malignant calcification detection were 77.8% and 94.4%, respectively, for FFDM versus 59.3% and 88.9%, respectively, for SM+DBT. Specificity was 100% for FFDM and 97.5% for SM+DBT. There were no statistically significant differences in either sensitivity or specificity between the study groups (p>0.89).

CONCLUSION

Relative to FFDM, SM in combination with DBT demonstrated a trend towards lower sensitivity for the detection of calcifications on screening examinations, although this did not reach statistical significance. There was no significant difference in specificity between the study groups. Further investigation with a larger dataset is ongoing.

CLINICAL RELEVANCE/APPLICATION

Relative to FFDM, SM in combination with DBT may have reduced sensitivity for the detection of calcifications, and therefore continued acquisition of FFDM images for screening examinations may be warranted.

SSA01-05 Cancer Detection with Digital Breast Tomosynthesis (DBT) Compared with Conventional Digital Mammography in Routine Breast Cancer Screening

Sunday, Nov. 26 11:25AM - 11:35AM Room: Arie Crown Theater

Participants

Maryam Etesami, MD, New Haven, CT (*Presenter*) Nothing to Disclose Michelle Y. Giwerc, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Malini Harigopal, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Laura J. Horvath, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Wajih Zaheer Kidwai, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Liane E. Philpotts, MD, New Haven, CT (*Abstract Co-Author*) Consultant, Hologic, Inc

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PURPOSE

Digital breast tomosynthesis (DBT) is known to increase cancer detection while reducing false positive recalls in screening mammography. However, the impact of additional cancers detected is not well understood. The purpose of this study was to assess detection rate, type, size and axillary lymph node status of cancers detected with DBT compared with digital mammography (DM) alone.

METHOD AND MATERIALS

This was a retrospective institutional review board approved, HIPAA compliant study with waiver of informed consent. DM screening mammograms performed from August 1, 2008 through August 1, 2011 and DBT screening mammograms performed from August 1, 2011 through August 1, 2016 at an academic center were reviewed. DBT screening mammogram was offered to all patients after installation. Cancer detection rates were calculated and compared between the DM and DBT screening mammograms. Histological type of detected cancers, their size, receptor phenotype and lymph node status based on sentinel axillary lymph node biopsy were compared between the 2 groups of DBT and DM only screening.

RESULTS

This study included a total of 44050 screening mammograms, 28282 (64%) DBT and 15768 (36%) DM only. The cancer detection rate was 5.41 per 1000 patients screened with DBT and 4.95 per 1000 patients screened with DM only (p=0.52). There was no significant difference in proportions of in situ and invasive cancers detected (67% and 70% invasive cancers with DBT and DM only, respectively. p=0.55). However, the cancers detected with DBT were significantly smaller ($1.54 \pm 1.4 \text{ cm}$) compared with cancers detected with DM only (2.30 ± 2.3 cm) (p=0.01). Additionally, axillary lymph node metastasis in invasive cancers was reduced to approximately half with DBT screening (14.7%) compared to DM only screening (30.9%) (p=03). DBT screening detected more invasive cancers with lobular histology (13%) compared with DM only (7%), but the difference was not statistically significant (p=0.29). There was no significant difference in receptor phenotype of the cancers detected by DBT compared to DM only screening.

CONCLUSION

DBT screening detects smaller cancers with fewer positive axillary lymph nodes compared to DM. This difference may translate to less systemic treatment and improved clinical outcomes.

CLINICAL RELEVANCE/APPLICATION

DBT screening may improve breast cancer early detection compared to DM which may lead to less systemic treatment and improved clinical outcomes

SSA01-06 Association of Breast Cancer Screening Utilization and Results with Uptake of Subsequent Preventive Services

Sunday, Nov. 26 11:35AM - 11:45AM Room: Arie Crown Theater

Participants

Stella Kang, MD,MSc, New York, NY (*Abstract Co-Author*) Author, Wolters Kluwer nv Miao Jiang, PhD, Reston, VA (*Abstract Co-Author*) Nothing to Disclose Richard Duszak JR, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose Samantha L. Heller, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Danny Hughes, PhD, Reston, VA (*Abstract Co-Author*) Nothing to Disclose Linda Moy, MD, New York, NY (*Presenter*) Nothing to Disclose

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PURPOSE

To assess for potential associations between screening mammography use and subsequent uptake of a variety of preventive services in the Medicare population, including pap smears, bone mass testing, and influenza vaccinations.

METHOD AND MATERIALS

Medicare claims from 2010-2014 Research Identifiable Files were used retrospectively to identify a group of women who underwent screening mammography and a control group without screening mammography in 2012. The screened group was divided into positive versus negative screening results, with the positive subgroup further divided into false positive and true positive findings. Bivariate and multivariate logistic regression models were used to examine the relationship between screening status and the probabilities of receiving a pap smear, bone mass measurement, or influenza vaccine in the subsequent two years. Sensitivity analysis was performed using a 2-year clean period for pap smear and bone mass testing prior to mammography for assessment of subsequent preventive service uptake.

RESULTS

The cohort consisted of 555,708 patients, 66.6% without screening mammography and 31.4% with mammography. After adjusting for patient demographics, comorbidity status, geographic covariates, and baseline preventive care, women who underwent an index screening mammogram (with either positive or negative results) were more likely than unscreened women to have a subsequent pap smear, bone mass measurement, and influenza vaccine (OR 1.52-2.75). Sensitivity analysis with a 2-year clean period for prior pap smear or bone mass testing also supported the positive association between breast cancer screening and subsequent uptake of preventive tests. Women with false positive screening mammogram results were no less likely to have a subsequent pap smear and

bone mass testing than women with negative screening results.

CONCLUSION

In female Medicare beneficiaries, screening mammography utilization is associated with higher likelihood of adherence to other preventive guidelines, and without a negative association between false positive results and near-term cervical cancer or osteoporosis screening. Potential effects of mammography on attitudes toward preventive testing merit further investigation.

CLINICAL RELEVANCE/APPLICATION

False positive mammograms do not deter women from undergoing cervical cancer or osteoporosis screening. Screening mammography use was associated with improved subsequent uptake of preventive tests.

SSA01-07 Unique Mammographically-Derived Compositional Signatures of Malignancy and Triple-Negative Breast Cancers

Sunday, Nov. 26 11:45AM - 11:55AM Room: Arie Crown Theater

Participants

Serghei Malkov, PhD, San Francisco, CA (Presenter) Nothing to Disclose Roman Camarda, San Francisco, CA (Abstract Co-Author) Nothing to Disclose Andrei Goga, San Francisco, CA (Abstract Co-Author) Nothing to Disclose Bonnie N. Joe, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose Jennifer S. Drukteinis, MD, Tampa, FL (Abstract Co-Author) Nothing to Disclose Heather I. Greenwood, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose Jesus A. Avila, San Francisco, CA (Abstract Co-Author) Nothing to Disclose Bo Fan, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose Karen Drukker, PhD, Chicago, IL (Abstract Co-Author) Royalties, Hologic, Inc. Bethany L. Niell, MD, Tampa, FL (Abstract Co-Author) Nothing to Disclose Leila Kazemi, RT, San Francisco, CA (Abstract Co-Author) Nothing to Disclose Karla Kerlikowske, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Maryellen L. Giger, PhD, Chicago, IL (*Abstract Co-Author*) Stockholder, Hologic, Inc; Stockholder, Quantitative Insights, Inc; Shareholder, QView Medical, Inc; Co-founder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Medical Systems Corporation John A. Shepherd, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose

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PURPOSE

To investigate the unique lipid, water, and protein composition of malignant breast cancers by receptor status to non-malignant breast tissue in a cohort of high risk women (BIRADS 4 or greater).

METHOD AND MATERIALS

A dual-energy mammography technique (3CB) was used to quantify lipid, protein, and water composition. The lesion dataset included malignant (invasive and DCIS, N=86) and non-malignant (fibroadenoma and benign, N=282) groups. The malignant group contained 10 triple-negative and 34 receptor-positive invasive cancers. Within regions identified by the radiologists, water, lipid, and protein measures were generated and within three surrounding rings of 2 mm thicknesses. Differences and ratios between lesions and rings were also calculated. Logistic regression with cross validation was applied to analyze lesion type separation.

RESULTS

The most significant variables to discriminate malignancy were lipid differences between lesion and rings (p-value (p) =10E-5, odds ratio (OR)=0.57), protein (water) difference between lesion and rings (p=10E-4, OR=1.66), and ratios of lesion water to rings (p=10E-5, OR=1.79). At the same time, the most significant variables of triple-negative and receptor-positive discrimination were lipid difference (negative) between ring 1 and ring 3 (p=0.03, OR=0.24 (0.065, 0.86)) and the increasing lipid levels (slope) from inner to outer ring (p=0.07, OR=2.44 (0.92, 6.5)). Thus, the lipid content within the lesion relative to the surrounding rings is a marker of malignancy, but the steeper lipid gradient outside of the lesion is a marker of triple-negative breast cancer.

CONCLUSION

We found biologically meaningful water, lipid, and protein compositions of lesion and its periphery that are statistically significant for malignancy/non-malignancy and triple-negative/receptor-positive separation. In addition, future studies will determine if the lipid gradient surrounding the lesion is indicative of active lipolysis within adjacent mammary adipocytes. If true, this advanced mammography imaging technique could aid in selecting patients that benefit from inhibition of this lipolysis.

CLINICAL RELEVANCE/APPLICATION

Advanced dual-energy mammography may reduce unnecessary biopsies and better select women with invasive cancer by receptor status.

SSA01-08 Breast Cancer Detection Rate of Supplemental Screening with Abbreviated MR for Women with Dense Breasts: Preliminary Results

Sunday, Nov. 26 11:55AM - 12:05PM Room: Arie Crown Theater

Participants

Susan Weinstein, MD, Philadelphia, PA (*Presenter*) Consultant, iCAD, Inc Mitchell D. Schnall, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose Elizabeth S. McDonald, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose Alice Chong, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Consultant, Hologic, Inc Consultant, Siemens AG

PURPOSE

Dense breast tissue decreases the sensitivity of mammography and many women with dense breasts are requesting supplemental screening such as whole breast ultrasound. At our institution we offer an abbreviated Breast MRI (AB-MR) examination as an option for women seeking supplemental screening. In this study, we evaluate the early outcomes of our AB- MR examination in asymptomatic women with dense breast tissue and negative recent mammography.

METHOD AND MATERIALS

An IRB approved and HIPAA compliant retrospective review was performed of women with who underwent supplemental screening with AB-MR examination. All women were asymptomatic. Their most recent mammogram was negative or benign (BI-RADS 1 or 2) and rated as "dense" (heterogeneous or extreme). The cancer detection and false positive rates were calculated based on pathologic correlation.

RESULTS

86 women underwent supplemental screening with AB- MR from January 2016 to April 2017. The age ranged from 41 to76 years, mean 56 years. Four patients (4.6%) were categorized as BI-RADS category 4. Pathology results revealed 1 invasive ductal carcinoma,1 invasive lobular carcinoma, 1 radial scar, and 1 case of fibrocystic change. The supplemental cancer detection rate with AB- MR was 2/86 or estimated to 23 per thousand with 2 false positive exams .

CONCLUSION

Given the additional cancer detection during our early implementation of AB- MR screening, the examination appears very promising as a supplemental screening tool in women with dense breasts However, more data is needed for validation.

CLINICAL RELEVANCE/APPLICATION

Our preliminary results suggest that the AB-MR may have a role as a supplemental screening option for women with dense breast tissue.

SSA01-09 Three-Dimensional Functional Infrared Imaging in Breast Cancer Screening Of Women with Dense Breasts: Observer Performance Study

Sunday, Nov. 26 12:05PM - 12:15PM Room: Arie Crown Theater

Participants

Carl J. D'Orsi, MD, Atlanta, GA (*Presenter*) Stock options, Hologic, Inc; Consultant, Real Imaging Ltd Elizabeth A. Krupinski, PhD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose Miriam Sklair-Levy, MD, Tel -Hashomer, Israel (*Abstract Co-Author*) Nothing to Disclose Tamar Sella, MD, Jerusalem, Israel (*Abstract Co-Author*) Nothing to Disclose Elkan F. Halpern, PhD, Boston, MA (*Abstract Co-Author*) Research Consultant, Hologic, Inc Research Consultant, Real Imaging Ltd Research Consultant, Gamma Medica, Inc Research Consultant, K2M Group Holdings, Inc David Izhaky, PhD, Airport City, Israel (*Abstract Co-Author*) Employee, Real Imaging Ltd

PURPOSE

Three-dimensional functional infrared imaging (3DIRI) based on multiparametric evaluation of metabolic imaging biomarkers, shows promise as an indicator for the risk of a current breast cancer in women with dense breasts. Women with *positive* 3DIRI result (high risk) were recommended to undergo adjuvant contrast-ehnahced screening MRI.The objective of this study was to assess and compare, in a retrospective reader study, radiologists' performance in detection of breast cancer using 2D digital mammography alone and using 2D digital mammography with 3DIRI.

METHOD AND MATERIALS

In this retrospective, multireader, multicase, sequential-design reader study, 10 radiologists, with varying mammography experience, interpreted a cancer-enriched set of 2D mammography and 3DIRI examinations. All imaging studies were of asymptomatic women with either heterogeneously or extremely dense breasts. Observers first interpreted the 2D mammogram alone and subsequently combined with the 3DIRI cancer risk result presented as a range of -100 to +100 with numbers in the negative range indicating, in a non-ordinal manner: "no risk" for current malignancy, to +100 for "risk of current malignancy". Radiologists rated examinations using forced BI-RADS categories 1-5 and probability of malignancy on a 100 point scale with 0 as "no possibility of malignancy present" and 100 as "malignancy present". The analysis included 40 cases: 30 noncancers and 10 histology confirmed cancer cases. Reader performance was compared using the receiver operating characteristics (ROC) curve and the area under the curve (AUC) for mammography alone and for mammography with 3DIRI.

RESULTS

Multi-reader pooled ROC analysis yielded AUC of 0.71 for mammography alone and 0.87 for mammography with 3DIRI, yielding a statistically significant 22% relative increase in AUC (change in AUC of 0.16 [95% confidence interval: 0.04-0.27]; p < 0.05).

CONCLUSION

Adding 3DIRI to mammography significantly improved reader's detection of breast cancer in women with dense breast tissue.

CLINICAL RELEVANCE/APPLICATION

3D functional infrared imaging, a non-contract, non-radiation imaging modality, can correctly classify women for their current risk of breast cancer with high efficacy Assessing the likelihood for breast cancer non-invasively can assist in risk-stratified screening programs





103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA02

Science Session with Keynote: Breast Imaging (Contrast Enhanced Mammography)

Sunday, Nov. 26 10:45AM - 12:15PM Room: N227B

BR

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

Participants

Christiane K. Kuhl, MD, Bonn, Germany (*Moderator*) Nothing to Disclose John M. Lewin, MD, Denver, CO (*Moderator*) Consultant, Hologic, Inc; Consultant, Novian Health Inc

Sub-Events

SSA02-01 Breast Keynote Speaker: Contrast Enhanced Mammography

Sunday, Nov. 26 10:45AM - 10:55AM Room: N227B

Participants

Martin J. Yaffe, PhD, Toronto, ON (*Presenter*) Research collaboration, General Electric Company; Founder, VOLPARA Technologies; Shareholder, VOLPARA Technologies; Co-founder, Mammographic Physics Inc

SSA02-02 Contrast-enhanced Digital Mammography Plus Mammography, Magnetic Resonance Imaging Plus Mammography and Mammography Alone: A Comparison of Diagnostic Performance in Symptomatic Women

Sunday, Nov. 26 10:55AM - 11:05AM Room: N227B

Participants Wei Tang, Shanghai, China (*Presenter*) Nothing to Disclose

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PURPOSE

To compare the diagnostic efficiency of contrast-enhanced digital mammography (CEDM) plus digital mammography (DM) and magnetic resonance imaging (MRI) plus DM in symptomatic women.

METHOD AND MATERIALS

Between June and December 2015, 196 patients with 240 histologically proven lesions all underwent DM, CEDM and MRI. Two radiologists were responsible for interpreting all images according to the Breast Imaging Reporting and Data System (BI-RADS). The diagnostic performance of each method was assessed by receiver-operating characteristic (ROC) curve. The sensitivity, specificity, accuracy, positive predictive value (PPV) and negative predictive value (NPV) were compared using McNemar's test and Fisher's exact test. A Kappa test was used to assess the interobserver agreement.

CONCLUSION

The diagnostic performance of CEDM and MRI combined with DM is superior to that of DM alone in symptomatic women; MRI plus DM is slightly better than that of CEDM plus DM, but this difference was not statistically significant

CLINICAL RELEVANCE/APPLICATION

Besides MRI, CEDM is a good tool for breast cancer diagnosing.

SSA02-03 Use of Contrast Enhanced Digital Mammography for Women with Palpable Breast Abnormalities

Sunday, Nov. 26 11:05AM - 11:15AM Room: N227B

Participants

Maxine S. Jochelson, MD, New York, NY (*Presenter*) Speaker, General Electric Company; Consultant, General Electric Company Elizabeth A. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Monica Morrow, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Blanca Bernard-Davila, MPH,MS, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Bridget O'Hara, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Aileen Cunnane, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Janice S. Sung, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

I o determine whether CEDM may replace the standard practice of mammography plus targeted ultrasound in the work-up of patients with palpable breast abnormalities.

METHOD AND MATERIALS

Patients presenting for evaluation of a palpable mass were consented for this prospective HIPAA-compliant and IRB-approved study between April 2015 and April 2017. 183 women with 200 palpable lesions were evaluable. The region of the palpable abnormality was marked. CEDM was performed with standard MLO and CC views plus a spot film over the palpable abnormality. Low energy images were interpreted first after which contrast enhanced images were provided. Targeted ultrasound was performed. Suspicious lesions were biopsied with appropriate imaging guidance. Any suspicious finding seen only on CEDM was evaluated by MRI for possible biopsy. If not seen on MRI, a 6-month follow up CEDM was performed. Detection rates and PPV3 for CEDM and ultrasound were calculated. Pathology and/or one-year follow up were the gold standard. Patient characteristics including age, menstrual status, breast density, breast parenchymal enhancement and risk factors were recorded.

RESULTS

Mean patient age was 52 (30-80 years). Eighty-three palpable lesions had no imaging correlate and 100 were cysts, fat necrosis or biopsied yielding other benign abnormalities. Seventeen malignant lesions were detected: 14/17 (82%) by CEDM and 16/17 (94%) by ultrasound. Ultrasound and CEDM missed the same cancer which was detected by MRI. PPV3 of CEDM was 42% and ultrasound 37% (p<.0001).

CONCLUSION

The cancer detection rate of CEDM in this population suggests that CEDM cannot be used to replace mammography plus targeted ultrasound in the work up of palpable abnormalities, although confirmation in a larger study is required for a definitive conclusion.

CLINICAL RELEVANCE/APPLICATION

A negative CEDM did not reliably exclude breast cancer. Mammography plus targeted ultrasound should remain the standard workup of women with palpable abnormalities.

SSA02-04 Utility of Contrast Enhanced Digital Mammography for Breast Cancer Screening

Sunday, Nov. 26 11:15AM - 11:25AM Room: N227B

Participants

Janice S. Sung, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Lizza Lebron, MD, New York, NY (*Presenter*) Nothing to Disclose Donna D. D'Alessio, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Delia M. Keating, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Carol H. Lee, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Elizabeth A. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Maxine S. Jochelson, MD, New York, NY (*Abstract Co-Author*) Speaker, General Electric Company; Consultant, General Electric Company

PURPOSE

To evaluate basic performance metrics of contrast enhanced digital mammography (CEDM) when used for breast cancer screening.

METHOD AND MATERIALS

IRB approved retrospective review was performed to identify CEDMs performed for routine breast cancer screening between December 2012- April 2016. Medical records were reviewed for risk factors (family history, personal history, BRCA status, prior high risk lesion). The number of biopsies recommended and cancers detected were recorded as well as the tumor histopathologies.

RESULTS

A total of 1197 screening CEDMs were performed during the study period. Median age was 52 (range: 25-82). 319 (27%) women had a family history of breast cancer in a 1st degree relative <50, 470 (39%) a personal history of breast cancer, 103 (9%) a known BRCA mutation, and 371 (31%) a history of a high risk lesion. 1073 (89%) studies were given a BI-RADS 1 or 2 assessment, 28 (2%) a BI-RADS 3, and biopsy recommended in 71(6%). MRI was recommended for further evaluation of a contrast only finding in 31 (3%) women. 22 cancers were detected (12 invasive ductal cancers, 2 invasive lobular cancers, 1 invasive mammary cancer, 7 cases of DCIS) for a PPV3 of 31% and a cancer detection rate of 18/1000.

CONCLUSION

CEDM is a promising technology that may be used for breast cancer screening of intermediate risk women. The BI-RADS 3 rate, PPV3, and relative proportion of DCIS to invasive cancers are comparable to screening mammography.

CLINICAL RELEVANCE/APPLICATION

CEDM may be a potential alternative screening technique for women at intermediate risk for breast cancer.

SSA02-05 Adding the Merits of Contrast to the Ease of Mammography: Can We Highlight What's Behind Breast Asymmetries?

Sunday, Nov. 26 11:25AM - 11:35AM Room: N227B

Participants

Rasha M. Kamal, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose Maha H. Helal IV, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Marwa A. Haggag, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Mohamed Gomaa, Mansoura, Egypt (*Abstract Co-Author*) Nothing to Disclose Amira H. Radwan, MBBCh, MA, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Mona A. Fouad III, MD, MSc, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Amr F. Moustafa, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Maher Hassan IV, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Amany M. Helal, MD,PhD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Ahmed Abdelaziz, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Yasmin Mounir, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Omniya Mokhtar, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Ahmed Abdal Latif IV, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

TThe purpose of this study is to assess the impact of including contrast mammography in the characterization of mammography identified breast asymmetries.

METHOD AND MATERIALS

This prospective study included 380 patients with mammography identified breast asymmetries: single view, focal, global and developing asymmetries. Contrast enhanced spectral mammography (CESM) was performed using the same machine. A pair of low and high energy images wastaken in each position. Lesions were classified into enhancing and non-enhancing lesions. Enhancing lesions (focus, mass and non-mass) were further categorized according to the ACR MRI BIRADS lexicon. Core and surgical biopsy was taken and histopathology results were correlated with the corresponding imaging findings and accordingly the diagnostic indices of mammography alone and when adding CESM were calculated and compared.

RESULTS

The study included 380 mammography identified breast asymmetries: 230/380 (60.5%), focal, 128/380 (33.7%) global 20/380, (5.3%) single view and 2/380 (0.5%) developing asymmetries. Additional mammography signs (microcalcifications, distortion and skin thickening) were identified in 56/380 cases and they strongly correlated with an underlying malignant pathology (p<0.05). After contrast injection, no contrast uptake was seen in 88 cases (74 benign and 14 malignant lesions). Enhancing lesions were classified as focus (16/380,), mass (121/380) and non-mass(155/380). The calculated sensitivity, specificity positive and negative predictive values of mammography were 82.8%, 46.8%, 66.8% and 75.7% as compared to 94.4%, 76.4%, 88.5% and 87.4% after adding CESM. False negative lesions on CESM were 14/380 non enhancing malignant lesions (mainly DCIS) while false positive cases were 30/380 inflammatory breast lesions and atypical fibroadenomas showing malignant morphology descriptors.

CONCLUSION

CESM should be incorporated in the diagnostic workup of breast asymmetries to highlight or exclude underlying malignant lesions with the exception of when an underlying inflammatory process is considered due to the high incidence of false positive results in this case.

CLINICAL RELEVANCE/APPLICATION

Mammography identified breast asymmetries pose a diagnostic challenge and they often entail un necessary diagnostic and interventional procedures. CESM when added to Mammography can help in the characterization of the underlying pathology.

SSA02-06 Automatic Classification of Breast Lesions in Contrast Enhanced Spectral Mammography Using Deep Learning

Sunday, Nov. 26 11:35AM - 11:45AM Room: N227B

Participants

Miriam Sklair-Levy, MD, Tel - Hashomer, Israel (*Presenter*) Nothing to Disclose Shaked Rose Perek, BSC, Tel Aviv, Israel (*Abstract Co-Author*) Nothing to Disclose Anat Shalmon, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose Osnat Halshtok, MD, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose Michael Gotlieb, MD, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose Nahum Kiryati, PhD, Tel Aviv, Israel (*Abstract Co-Author*) Nothing to Disclose Gali Zimmerman Moreno, MSc, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose Arnaldo Mayer, PhD, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

This work presents a method for automatic breast lesion classification in dual energy contrast enhanced spectral mammography (CESM). The aim is to assess its feasibility and to evaluate the potential for biopsy sparing in benign breast lesions.

METHOD AND MATERIALS

A dataset of 130 CESM breast lesions was generated retrospectively from 65 benign and 65 malignant lesions following biopsy. Each lesion was manually contoured using standard PACS viewer drawing tools. Based on this data set, a supervised learning algorithm was developed to tell apart benign from malignant lesions. A supervised classifier was constructed using deep learning methods (DL) in conjunction with transfer learning. The transfer learning approach begins with a pre-trained neural network (AlexNet), trained on the ImageNet database, comprised of 14 million natural images from 1000 different classes. This network was further fine-tuned for our CESM data set, in order to extract strong features representing the characteristic patterns of benign and malignant lesions. A subset of 82 lesions was used to train the network (back-propagation) while 13 other provided inter-epoch validation. Eventually, the trained network was tested on the remaining set of 35 lesions (which were not used for training). A classification score was generated by the network for each lesion in the test set (see the Figure; benign -blue and malignant-red). A higher score signifies a higher probability for that lesion to be malignant. Malignant/benign classification is performed by imposing a selected threshold value on the classification score. The value of this threshold determines the sensitivity and specificity of the corresponding working point.

RESULTS

Setting a conservative score threshold of 0.2 (Figure), leads to Sensitivity = 0.95 and Specificity = 0.47, corresponding to a potential 47% sparing in biopsies at the cost of 1 false negative.

CONCLUSION

This work demonstrates the feasibility of automatic lesion classification in dual energy CESM images. The method has the potential to reduce the number of benign breast biopsies while preserving high sensitivity.

CLINICAL RELEVANCE/APPLICATION

Automatic, or computer assisted lesion classification in CESM images has the potential to reduce the number of benign breast biopsies, thereby reducing both the patient anxiety and the medical costs.

SSA02-07 Contrast-enhanced Cone-beam Breast-CT (CBCT) vs Non-contrast CBCT, Mammography and MRI: Diagnostic Accuracy for Breast Cancer Detection in Dense Breast Tissue

Sunday, Nov. 26 11:45AM - 11:55AM Room: N227B

Participants

Susanne Wienbeck, MD, Goettingen, Germany (*Presenter*) Nothing to Disclose Uwe Fischer, MD, Goettingen, Germany (*Abstract Co-Author*) Nothing to Disclose Christina Perske, Goettingen, Germany (*Abstract Co-Author*) Nothing to Disclose Susanne Luftner-Nagel, Goettingen, Germany (*Abstract Co-Author*) Nothing to Disclose Joachim Lotz, MD, Gottingen, Germany (*Abstract Co-Author*) Research Cooperation, Siemens AG Johannes Uhlig, Goettingen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic accuracy of contrast-enhanced cone-beam breast-CT (CE-CBCT) in dense breast tissue and compare it to non-contrast CBCT, mammography (MG) and magnet resonance imaging (MRI).

METHOD AND MATERIALS

In this prospective ethics-board approved study, 41 women (52 breasts, 100 lesions), median age of 57.9 years (IQR 48.9-64.9, range 41.6-78.6 years) with ACR density type c or d and BI-RADS 4 or 5 assessment in MG and/ or ultrasound were included. Based on amended ACR BI-RADS criteria, MG, non-contrast CBCT, CE-CBCT and MRI were independently evaluated by two blinded readers. The area under the receiver operating curve (AUC), sensitivity and specificity were compared between the different imaging modalities. All data were evaluated by means of descriptive statistics. ANOVA-type statistics were used for comparison.

RESULTS

Histological examination was performed on 63 breast lesions (6 benign, 6 high-risk, 51 malignant). Follow-up imaging was performed for 37 lesions. The AUCs for breast cancer diagnosis for reader 1 and 2 were: 0.79/ 0.69 (CE-CBCT), 0.78/ 0.76 (MRI), 0.70/ 0.62 (non-contrast CBCT) and both 0.69 (MG). CE-CBCT improved breast cancer diagnosis sensitivity by 30-37% in comparison to MG, and was comparable to MRI (MG: 0.84/ 0.93 vs. MRI: 0.70/ 0.86). Associated ANOVA-type statistics for differences in AUC and sensitivity across imaging modalities were p=0.0443 and p<0.001, respectively.

CONCLUSION

This study showed that CE-CBCT can accurately identify malignant breast lesions in a diagnostic setting. CE-CBCT improved lesion detection in comparison to MG and non-contrast CBCT and was comparable to MRI in density type c and d breasts.

CLINICAL RELEVANCE/APPLICATION

The results show that CE-CBCT is a promising new method that may be a suitable alternative to MRI in patients with contraindications to MRI or in regions with limited MRI availability.

SSA02-08 The Impact of Automated Breast Ultrasound versus Contrast Enhanced Spectral Mammography on the Local Staging of Breast Cancer

Sunday, Nov. 26 11:55AM - 12:05PM Room: N227B

Participants

Maha H. Helal IV, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose Sahar Mansour, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Rana H. Khaled, MSc, MBBCh, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Omar Zakaria, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Omnia Mokhtar, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Marwa A. Haggag, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose Rasha M. Kamal, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

to compare contrast enhanced spectral mammography and automated breast ultrasound with regards to cancer size, extension and multiplicity in reported cases with breast cancer

METHOD AND MATERIALS

Institutional review board approval and patient informed consent were obtained from 70 patients with proved breast cancer (64% invasive ductal grade II, 16% invasive ductal grade III and 20% invasive lobular). 3D ABUS were done for anteroposterior ;lateral and medial acquisitions and CESM performed using low and high energy exposures in craniocaudal and mediolateral oblique views after IV injection of contrast agent. Included breast cancers were analyzed regarding disease extension, size, and multiplicity.Operative data was the gold standard reference

RESULTS

Was superior in evaluating cancer extension to the surroundings (parenchyma +/- skin) with an accuracy of 90% compared to 87% for CESM. Multiplicity was better demonstrated by CESM that showed an accuracy of 96% compared to 90% by ABUS. The overall performance of CESM in staging of breast cancer was 95.7% sensitivity, 88% specificity and 93% total accuracy versus 95%, 76.5% and 91.3% respectively for ABUS.

CONCLUSION

3D ABUS is a non-invasive alternative tool to CESM in the staging of breast cancer. ABUS was non-inferior to CESM in the evaluation of cancer size. 3D ABUS is more accurate in determining parenchymal infiltration and CESM is better in detection of multiplicity.

CLINICAL RELEVANCE/APPLICATION

ABUS is considered a revolution in breast scanning by ultrasound imaging that can be used as a non-invasive, fast and easy tool of breast imaging in early detection (in other words; screening) and staging of breast carcinomas

SSA02-09 Comparison of MRI, CEM and MBI for Staging Breast Cancer in Women with a Newly Diagnosed Breast Cancer

Sunday, Nov. 26 12:05PM - 12:15PM Room: N227B

Participants

Jules H. Sumkin, DO, Pittsburgh, PA (*Presenter*) Institutional research agreement, Hologic, Inc Advisory Board, General Electric Company

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PURPOSE

To compare MRI, MBI and CEM imaging assessments of index lesions and extent of disease with pathology in patients with newly diagnosed breast cancer.

METHOD AND MATERIALS

We compared results from 79 women with biopsy-proven breast cancers in 80 breasts who underwent, under an IRB-approved protocol, MRI, MBI and CEM within one week. Six specifically trained, breast radiologists participated in the study. Each examination was independently interpreted prospectively by one radiologist with full access to all prior breast imaging, but blinded to the interpretations of the two other study modalities. Findings for the 80 cancers were recorded and compared in a side by side review/correlation with surgical pathology (59 cases) and in neo-adjuvant treated cases (21) with image-guided biopsy results.

RESULTS

The primary cancers consisted of 40 IDC, 17 IDC/DCIS, 18 ILC, and 4 DCIS and 1 IDC/ILC only. Segmental mastectomy or mastectomy was performed on 57 women, (58 breasts) without neo-adjuvant therapy and 51 of these were detected by all three modalities. The average size by pathology of the primary index cancers was 31 mm and were measured by the radiologists on imaging as 33 mm, 29 mm and 32 mm for MRI, CEM and MBI, respectively (p=0.17). The range in imaging sizes for primary index cancers was 3-95 mm by pathology. Four verified index lesions were missed on CEM, four on MBI and three on MRI. 7 cases were correctly upstaged from an original diagnosis of unifocal to multi-focal (3 MRI, 2 CEM, and 3 MBI) and multi-centric (2 MRI, 2 CEM, and 1 MBI). MRI depicted 42 false positive enhancing regions, CESM 16, and MBI 16 (p<0.01). A radiologist rendered a report considering all imaging studies that led in 6 cases to changes in surgical management based on the additional information provided. Of these, 2 were affected by all three modalities, while 1 primarily by MRI, 3 primarily by CEM, and none primarily by MBI.

CONCLUSION

All three modalities performed comparably in terms of sensitivity and in estimating tumor size, as compared with surgical pathology. MRI was slightly more sensitive than CEM and MBI, but had significantly more false positives than CEM and MBI.

CLINICAL RELEVANCE/APPLICATION

Breast MRI is extremely sensitive for cancer staging, but has more false positive findings. Access and expense issues remain. MBI and CEM are possible alternatives to MRI for this purpose.





103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA03

Cardiac (Anatomy and Function)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S502AB



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

FDA Discussions may include off-label uses.

Participants

Scott R. Akers, MD, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose Carole J. Dennie, MD, Ottawa, ON (*Moderator*) Speaker, Bayer AG; Spouse, Consultant, Abbott Laboratories

Sub-Events

SSA03-01 Sparse CINE SSFPs for Assessment of Left Ventricular Mass in Cardiac MRI: Accuracy in Patients with Structural Myocardial Inhomogeneities

Sunday, Nov. 26 10:45AM - 10:55AM Room: S502AB

Participants

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PURPOSE

To investigate in a sparse 2D real-time CINE TrueFISP sequence featuring iterative reconstruction (SSIR) possible influence of structural myocardial inhomogeneity indicated by presence of late-gadolinium enhancement (LGE+) with regard to accuracy of left ventricular (LV) mass assessment.

METHOD AND MATERIALS

In patients undergoing cardiac MRI on a 3 Tesla system the SSIR sequence was acquired - once in a single-breath-hold (sBH) and once during free breathing (non-BH) -, as well as the fully-sampled multi-breath-hold reference standard sequence (RS) for LV analysis. LV mass assessment was performed with dedicated software (Argus, Siemens Healthcare Sector). Agreement of SSIR and RS for mean LV mass (LVMavg) and end-diastolic LV mass (LVEDM) was determined with Bland-Altman-analysis and linear regression analysis.

RESULTS

51 patients (25 LGE+; 26 LGE-) who underwent LGE-imaging and LV analysis with the RS and the SSIR sequence were investigated. Linear regression analysis revealed with sBH-SSIR in comparison to RS excellent correlation coefficients r from 0.95-0.96 in LGE+ patients, from 0.96-0.99 in LGE- patients and with non-BH-SSIR r from 0.97-0.98 in LGE+ and 0.95-0.98 in LGE- patients, respectively. Significant overestimation was found in Bland-Altman-analysis in sBH-SSIR and non-BH-SSIR LV mass assessment in both LGE+ and LGE- patients when compared to RS results (all p-values < 0.05).

CONCLUSION

Albeit high correlation of SSIR and RS results regarding LV mass assessment, significant LV mass overestimation was found using SSIR datasets for LV analysis- both when acquired with a single breath-hold or during free breathing. Results don't differ between LGE+ and LGE- patients.

CLINICAL RELEVANCE/APPLICATION

Albeit high correlation of SSIR and RS measurements, LV mass is systematically overestimated when using sparse sampling featuring iterative reconstruction (SSIR) imaging for the analysis.

SSA03-02 Left Ventricular and Left Atrial Volumetric Function: Impact of Inspiratory Breath Holding

Sunday, Nov. 26 10:55AM - 11:05AM Room: S502AB

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PURPOSE

To compare left ventricular and left atrial volumetric function employing the same cine imaging technique during inspiratory breathhold and during free breathing.

METHOD AND MATERIALS

49 subjects without symptoms of cardiopulmonary diseases underwent steady-state free precession cine real-time imaging during inspiratory breath-hold and free breathing at 3T. The left ventricle (LV) and the left atrium (LA) were covered in 4-chamber orientation. LV (end-diastolic volume, EDV; end-systolic volume, ESV) and LA (maximum, LAVmax; minimum, LAVmin; before contraction, LAVbc) volumes were derived by semi-automatic segmentation. LV stroke volume (SV) and ejection fractions (LV ejection fraction, EF; total/passive/contractile LA ejection fraction; LATEF/LAPEF/LACEF) were calculated. LV peak ejection rate (PER) as well as LV early (PFRE) and late (PFRA) diastolic peak filling rates were derived from LV volume-time curve. Corresponding breathing and breath-hold parameters were compared by paired t-test and correlation analysis.

RESULTS

All LV and LA volumes decreased during inspiratory breath-hold, EDV, ESV and LAVmax significantly (EDV, $136\pm28 \text{ ml} \text{ vs. } 131\pm31 \text{ ml}$, p=0.04; ESV, $62\pm17 \text{ ml} \text{ vs. } 59\pm17 \text{ ml}$, p=0.01; SV, $74\pm15 \text{ ml} \text{ vs. } 67\pm17 \text{ ml}$, p=0.21; LAVmax, $86\pm18 \text{ ml} \text{ vs. } 80\pm18 \text{ ml}$, p<0.01; LAVmin, $46\pm13 \text{ ml} \text{ vs. } 46\pm13 \text{ ml}$, p=0.57; LAVbc, $63\pm16 \text{ ml} \text{ vs. } 62\pm16 \text{ ml}$, p=0.35). PER was not altered during breath-hold (-410\pm83 ml/s vs. -416\pm95 ml/s; p=0.38), diastolic filling rates significantly decreased (PFRE, $334\pm88 \text{ ml/s} \text{ vs. } 299\pm97 \text{ ml/s}$; p<0.01; PFRA: 283±81 ml/s vs. $259\pm82 \text{ ml/s}$; p<0.01). LATEF ($47\pm6\% \text{ vs. } 43\pm8\%$, p<0.01) and LAPEF ($27\pm5\% \text{ vs. } 22\pm6\%$, p<0.01) significantly decreased during inspiratory breath-hold whereas EF ($55\pm6\% \text{ vs. } 55\pm6\%$, p=0.22) and LACEF ($27\pm6\% \text{ vs. } 27\pm7\%$, p=0.52) did not reveal significant differences. Correlations between breathing and breath-hold parameters ranged from r=0.66 for LACEF to r=0.87 for LAVmin and EF.

CONCLUSION

Inspiratory breath-holding significantly alters left ventricular and left atrial volumetric function. Moreover, derived correlation coefficients indicate substantial variations in the individual effect of inspiratory breath-holding between subjects.

CLINICAL RELEVANCE/APPLICATION

Breathing state should be taken into account in the assessment of left ventricular and atrial function, especially for follow-up of patients and comparison of parameters with echocardiography.

SSA03-03 Left Atrial Appendage Closure Guided By 3D Printed Patient-Specific Models

Sunday, Nov. 26 11:05AM - 11:15AM Room: S502AB

Participants

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PURPOSE

Percutaneous left atrial appendage (LAA) occlusion has emerged as an alternative therapeutic approach to medical therapy for stroke prevention in patients affected by atrial fibrillation. Our aim was to assess whether the sizing of the implanted occluder device, based on the sole medical image analysis, is in accordance with the sizing obtained using the 3D printing models recostructed by computed Tomography Angiography (CTA).

METHOD AND MATERIALS

We used 3D printing to create patient-specific LAA models. We retrospectively identified 13 cases of LAA occlusion. For each case, we segmented the pre-operative CTA scan by ITK-snap creating a LAA 3D model (Caretronik, Prato, Italy), that was considered suitable for 3D stereolithography printing (SLA) technique (Form 2 Desktop, Formlabs Inc., MA, USA). Two independent observers measured the LAA landing zone, major and minor axis. The measurements were used for sizing. A rehearse occlusion was then accomplished using the 3D printed LAA and the occluder device models; the resulting values were subsequently compared with the size of the implanted device to assess agreement, over or underestimation and its correlation with post-operative drawbacks.

RESULTS

Thirteen patients, undergoing percutaneous LAA occlusion, were retrospectively analyzed; for each of them a patient-specific 3D LAA printed model was manufactured using pre-operative CTA images. The comparison between the 3D printed model sizing and the actual sizing revealed that: i) in 54% of the cases (n=7) the actual sizing was underestimated when compared to the 3D printed model; ii) in 38% of the cases (n=5) the two sizing approaches matched; iii) only in 1 case (8%) an overestimation of the actual size compared to the 3D printed model was detected. It is worth noticing that in all underestimated cases a drawback, such as leakage or device migration was observed; consequently, the results suggest that the use of 3D printing models help in finding the correct size of the device, potentially avoiding the negative outcome of the surgery.

CONCLUSION

3D printing LAA model may contribute in sizing the device, finding its correct position and guiding the choice of the device, providing additional data to angiography and TEE.

CLINICAL RELEVANCE/APPLICATION

3D printing left atrium appendage model may contribute in sizing the device, finding its correct position and guiding the choice of the device.

SSA03-04 Deformable Registration Based Analysis of Cine MR for Quantification of Regional Myocardial Function: Validation with Myocardial Tagging

Sunday, Nov. 26 11:15AM - 11:25AM Room: S502AB

Participants

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PURPOSE

The aim of this study is to validate deformable registration algorithms using cine SSFP data for analysis of myocardial strain in comparison to myocardial tagging.

METHOD AND MATERIALS

17 patients referred for cardiac MRI and 17 healthy volunteers were prospectively enrolled. LV peak systolic global longitudinal strain (GLS) and peak systolic global circumferential strain (GCS) were measured on respective long and short axis SSFP cines using a prototype automatic contouring tool (Langrangian strain) with integrated inverse deformable registration analysis (DRA) (TrufiStrain, Siemens Medical Solutions, Princeton, US). In identical slice orientation tagging was performed with subsequent HARP analysis for reference-standard comparison (Eulerian strain). For assessment of intra-observer variation, a repeat analysis of data was performed after >=4 weeks. Statistical testing included paired t-test, linear regression analysis, Pearson's correlation and coefficient of variance (CV) analysis.

RESULTS

Evaluated strain data using DRA and HARP demonstrated significant relationships to left ventricular ejection fraction (all P<0.0001). DRA demonstrated strong correlations with HARP for myocardial GLS (r=0.87; P<0.0001) and GCS (r=0.78; P<0.0001). Similar results were found for endocardial GLS (r=0.78; P<0.0001) and GCS (r=0.72; P<0.0001). For endocardial GCS (-18.7%; IQR:-22.2/-16.8% vs. -15.7%; IQR:-18.8/-13.8%; P<0.0001) and myocardial GLS (-13.7; IQR:-16.6/-11.4% vs. -12.2; IQR:-14.6/-9.5%; P<0.0001) DRA measures were significantly lower than HARP with no differences for myocardial GCS and endocardial GLS (P=NS). DRA demonstrated substantially lower intra-observer variation than HARP for endocardial GLS (CV 3.3/6.6\%) and GCS (CV 3.8/7.7\%) as well as myocardial GLS (CV 1.6/7.6\%) and GCS (CV 2.4/9.3\%).

CONCLUSION

Deformable registration based analysis of cine SSFP data provides an accurate and highly reproducible alternative to myocardial tagging for myocardial strain assessment without the need for additional image acquisition (i.e. tagged images). Identifiable differences in absolute values likely relate to differences in the applied reference frame of methods (Lagrangian vs. Eulerian strain).

CLINICAL RELEVANCE/APPLICATION

Automated, accurate and reproducible measurement of strain using standard cine SSFP data can promote routine use of this technique in clinical practice for identification of subclinical myocardial dysfunction.

SSA03-05 The Application of Optimized TPAT Technique in Arrhythmia Patients

Sunday, Nov. 26 11:25AM - 11:35AM Room: S502AB

Participants

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PURPOSE

Traditional CMR cine sequence is an useful tool for assessing the movement of heart. However, the poor image quality and motion artifacts caused by arrhythmia may hamper the diagnostic quality of CMR images. Now, the optimized temporal parallel acquisition technique (TPAT) can allowing free-breathing of subjects and meanwhile provides a similar diagnostic values for radiologists, which may improve this situation.

METHOD AND MATERIALS

Experiment: Twenty-five patients with arrhythmia and thirty-three patients with normal heart rhythm were included in this study. CMR scan was performed using a 3.0T system. Cine images were acquired by bSSFP sequence with conventional retrospective ECGtriggering method and the optimized real-time TPAT technique in the same planes. Image analysis: For quantitative analysis, LV segmental myocardial longitudinal strain(LS), LV circumferential strain and radial strain(CS and RS) were measured by dedicated software (CVI42 version 5.3.0), LV volumes and function were measured using Argus software (Siemens Healthcare, Erlangen, Germany). LV volumes and function were measured in the short axis level. Apparent contrast-to-noise ratio (CNR) between LV myocardium and blood pool was calculated. Besides, LV segmental myocardial thickness were also measured.

RESULTS

In the normal rythm group, there were no differences in evaluation of LV volumes, function and segmental myocardial thickness between the conventional method and TPAT technique. while there are obvious difference (p<0.05) on EF,LVSV,LVESV,LVCO and Mass in patients with arrythmia. (table 1,2). In addition,there were no obvious difference on radial strain, circumferencial strain and longitudial strain in the normal group. However, in patients with arrythmia, the values of basal anterior,basal anteroseptal,mid anterolateral,apical anterior and apical lateral of radial strain, basal anterior,basal anteroseptal,mid Inferolateral,mid anterolateral of circumferencial strain and mid anterolateral longitudinal strain were significantly different.(table 3.) The IQ of TPAT technique was higher than that of conventional method in patients with arrythmia on the whole. (Figure 1).

CONCLUSION

In conclusion, optimized TPAT technique can provide better IQ in most patients with arrhythmia, and it also has the advantages of allowing free-breathing scans.

CLINICAL RELEVANCE/APPLICATION

For patients with arrythmia, it will make the exam better.

SSA03-06 Compressed Sensing Real-Time Cine Imaging in Patients with Cardiac Arrhythmia: Does It Help to Reduce Mis-Triggering Artifacts?

Sunday, Nov. 26 11:35AM - 11:45AM Room: S502AB

Participants

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PURPOSE

To evaluate the impact of a Compressed Sensing (CS) real-time prototype cine sequence (Sparse 2D cine, Siemens Healthineers) on mis-triggering artefacts and image quality in patients with arrhythmia, in comparison with the reference cine-imaging technique.

METHOD AND MATERIALS

71 consecutive adult patients (41 males; mean age = 59 ± 20.6 years), referred for cardiac magnetic resonance (CMR) examination with concomitant irregular heart rate (defined by R-R interval variation > 10%) during scanning, were prospectively enrolled. For each patient, two series of cine images were systematically acquired: (a) a standard segmented multi-breath-hold steady-state free precession (bSSFP) sequence including short-axis stack, one four-chamber slice, one two-chamber slice (Group 1) and (b) an additional real-time CS single-breath-hold prototype sequence (Group 2) providing the same slice number, position and thickness as the reference technique. Two radiologists independently assessed mis-triggering artefacts, objective and subjective image quality for both acquisition techniques.

RESULTS

The mean heart rate variation was $38\% \pm 22.8$ (range: 11 - 122). A total of 609 cine slices were evaluated in each Group (mean number of slices per patient = 8.6 ± 1.9). The average number of slices with mis-triggering artefacts per patient was higher in Group 1 than in Group 2 (4.5 ± 2.9 vs 0.1 ± 0.5 , p<0.0001). The European CMR registry standardized artefact score was lower in Group 2 than in Group 1 (1.0 ± 1.2 vs 2.37 ± 1.2 respectively, p<0.0001). Subjective image quality score was improved in Group 2 compared to Group 1 (3.3 ± 0.9 vs 2.7 ± 1.0 respectively, p=0.0002).

CONCLUSION

Compressed Sensing real-time cine imaging drastically reduces mis-triggering artefacts and improves image quality of CMR cine acquisition in patients with arrhythmia.

CLINICAL RELEVANCE/APPLICATION

In addition to reduce CMR scan time, CS real-time cine imaging improves the interpretability of CMR cine images in patients with arrhythmia with almost no mis-triggering artefacts.

SSA03-07 Comparison of Cardiac and Late-Enhancement Dual-Energy CT with Electro-Anatomical Maps in Patients with Implanted Cardioverter-Defibrillator before Ventricular Radiofrequency Ablation

Sunday, Nov. 26 11:45AM - 11:55AM Room: S502AB

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PURPOSE

To compare characteristics of myocardial scar as assessed with cardiac and late-enhancement dual-energy CT (DECT) during preinterventional imaging with the findings obtained with electro-anatomical mapping (EAM) acquired during radio frequency cardiac ablation (RFCA).

METHOD AND MATERIALS

A total of 12 patients referred for catheter ablation of ventricular tachycardia (VT), who were not eligible for MRI due to incompatible implantable cardioverter-defibrillators (ICD's), were assessed for left ventricular wall thinning (WT) and wall motion abnormalities (WMA) on a cardiac scan as well as for scarring on late-enhancement images acquired using a DECT (Siemens Somatom Flash, Forchheim, Germany). Voltage maps were acquired during RFCA to identify myocardial segments with scar (Bipolar <1.5mV, unipolar <8mV). Using the 17-Segment AHA Model, segmental comparison between areas of WT, WMA and scar on CT and EAM was performed. Descriptive statistics and Cohen's kappa test were applied.

RESULTS

Wall thinning was observed in 10 out of 12 patients, wall motion abnormalities in all 12 patients and scars in 11 out of 12 patients on CT scans. Also, left ventricular wall involvement and mural distribution were noted. Overall segmental concordance between CT and EAM was observed in an average of 11 out of 17 segments ($\kappa = 0.55$), no concordance was seen for an average of 2 segments. An average of 4 segments was not evaluable due to missing data points on EAM. CT identified segments characterized by low voltages with high sensitivity (84.6%), reasonable specificity (75.9%) and reasonable negative predictive value (75.8%).

CONCLUSION

Cardiac CT with late-enhancement dual-energy phase is a valuable method to assess patients with a non-MRI compatible ICD prior to scar ablation. It can provide a 3-dimensional characterization of VT scar substrate, areas of wall thinning and of abnormal wall motion in addition to an anatomic model of the heart.

CLINICAL RELEVANCE/APPLICATION

Pre-interventional cardiac and late-enhancement dual-energy CT offers assistance to plan EAM and RFCA procedures in patients not eligible for MRI.

SSA03-08 Evaluation of Left Atrial Appendage Emptying after Successful Radiofrequency Catheter Ablation of Atrial Fibrillation: Cardiac Magnetic Resonance Imaging Study

Sunday, Nov. 26 11:55AM - 12:05PM Room: S502AB

Participants

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PURPOSE

To evaluate the flux and timing of left atrial appendage (LAA) emptying using velocity encoding cardiac magnetic resonance imaging (VENC-MRI) in patients who underwent successful catheter ablation of atrial fibrillation (AF).

METHOD AND MATERIALS

42 patients (mean age: 57.6 ± 10.7 years, male: 33) underwent VENC-MRI for quantification of LAA emptying after successful catheter ablation of AF. From VENC-MRI data during sinus rhythm, the maximum blood flow from LAA to left atrium was defined as the LAA emptying. Depending on the timing of LAA emptying, all patients were divided into two groups: 1) left ventricular systolic phase (LVSP) emptying and 2) left ventricular diastolic phase (LVDP) emptying. Additionally, the flux (in ml/s) of LAA emptying was measured.

RESULTS

Of all 42 patients, 11 (26.1%) performed the electrical isolation of pulmonary vines as well as LAA. In basis of VENC-CMR results, 34 (81%) and 8 (19%) were assigned into 1) LVSP emptying and 2) LVDP emptying, respectively. Mean flux of LAA emptying was significantly greater in the LVDP emptying than in the LVSP emptying (74.9 \pm 22.4 ml/s vs. 38.0 \pm 20.4 ml/s, p <0.001). Using the presence of LVSP emptying to predict the prior electrical isolation of LAA gave 72.7% sensitivity, 100% specificity, and 100% positive and 91.1% negative predictive values.

CONCLUSION

The VENC-MRI can allow the comprehensive evaluation of LAA emptying related to the electrical isolation of LAA in patients who terminated AF with catheter ablation.

CLINICAL RELEVANCE/APPLICATION

Velocity encoding cardiac magnetic resoance imaging can help assess noninvasively the pattern of left atrial appendage emptying in normal sinus after successful catheter ablation of atrial fibrillation.

SSA03-09 Deep Learning for Cardiac MRI: Automatically Segmenting Left Atrium Expert Human Level Performance

Sunday, Nov. 26 12:05PM - 12:15PM Room: S502AB

Participants

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PURPOSE

To develop a deep learning based fully automatic segmentation engine for left atrium (LA) and proximal pulmonary veins (PPVs) from cardiac MR images

METHOD AND MATERIALS

We acquired a publicly available, anonymized cardiac MRI data set from STACOM 2013 image segmentation challenge, providing a bias-free evaluation framework for LA and PPV segmentation and volume measurements. The dataset includes 10 training MR volumes with labeled LA and PPVs by expert radiologists through their manual annotations. MR images were obtained from a 1.5T Achieva (Philips Healthcare, The Netherlands), ECG-gated 3D balanced steady-state free precession acquisition, TR/TE = 4.4/2.4 ms, and Flip-angle = 90. In-plane resolution was 1.25×1.25 mm2, slice thickness was 2.7 mm. Our proposed method is novel and based on a deep convolutional neural network (CNN) with a new loss function (Fig 1A). We utilized three different views of the MRI with separate deep learning strategy to make the computational cost manageable (Fig 1B). We artificially increased the number of training samples to solve the need of big data in CNN training (~60,000 2D MRI slices were adapted in our case). After fusing three different networks coming from different views of MRI, we used the sensitivity, specificity, dice index (DI) and surface-to-surface (S2S) distances to measure segmentation performance.

RESULTS

The STACOM 13 challenge provided bias-free evaluation of the proposed method as follows: the proposed method takes only 10 seconds to segment the LA on the GPU and 7.5 minutes on CPU. The DI and S2S metrics for the LA and PPVs using our proposed method were 95.1%, 68.5%, 1.045 mm, and 1.427 mm, respectively (Fig 1C). This outperforms all the other methods in the literature and has similar to expert-human level performance in accuracy, and better than human-level-performance in efficiency.

CONCLUSION

We have designed a deep learning based segmentation method to accurately calculate the LA and PPVs volumes. This will prove particularly useful in mapping the LA and PPVs prior to ablation procedures used to treat atrial fibrillation. Compared to expert human-level performance, the proposed method achieved a high level of accuracy and efficiency.

CLINICAL RELEVANCE/APPLICATION

The proposed computer algorithm has great potential in the clinical applications of cardiac diseases, specifically in mapping of the LA and PPVs prior to ablation for treatment of atrial fibrillation.







SSA04

Cardiac (Coronary Artery Disease and Fractional Flow Reserve)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S504AB

СА СТ

AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: <u>1.75</u>

FDA Discussions may include off-label uses.

Participants

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Sub-Events

SSA04-01 Impact of CT FFR on Reader Confidence for CCTA Studies

Sunday, Nov. 26 10:45AM - 10:55AM Room: S504AB

Participants

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PURPOSE

To investigate whether reader confidence for characterization of coronary artery disease (CAD) improved when fractional flow reserve (CTFFR) calculated from cardiac computed tomography angiography (CCTA) was read in conjunction with anatomic CCTA.

METHOD AND MATERIALS

This IRB approved HIPAA compliant quality assessment study included 50 patients (27 male, age 67±12 years, BMI 28.7±5.3km/m^2). CCTA was acquired on a 3rd generation dual source MDCT (Siemens Force, Forchheim, Germany). FFR-CT was calculated (HeartFlow, Redwood City, CA). Four readers with 0.5, 1.5, 6, and 10 years of CCTA experience assessed each dataset twice, with CCTA only and with CCTA and FFR-CT data. Reader confidence to diagnose CAD and exclude hemodynamically significant stenosis (HS) were rated on a 4-point scale (1= high, 2=good, 3=moderate, and 4= not confident) for 4 coronary artery segments (CAS): left main (LM) left anterior descending (LAD), left circumflex (LCX), and right coronary artery (RCA). Time to interpret each examination was recorded. Non-parametric statistics were utilized.

RESULTS

Eight hundred CAS were evaluated. 15, 8, 11, and 16 cases were CAD RAD 1, 2, 3 and 4a, respectively. 64 VS in 33 cases had a stenosis with an FFR-CT values <0.8. Reader confidence increased significantly for CAD and HS (p=0.0001) with an improvement in 93 (11.6%) and 190 (23.8%) CAS and a decline in 27 (3.4%) and 32 (4%) CAS, respectively. The median change in level of confidence was -1 (range -3 to 2) and -2 (range -3 to 2) for CAD and HS, respectively. For the VS, we observed the highest increase of confidence to exclude HS for the LAD (p<0.0001), RCA (p<0.0001) LCX (p<0.0001), and LM (p<0.0001) with median changes of -2 (-3 to 2), -1 (-3 to 2), and -1 (-3 to 1), respectively. Readers with more than 5 years' experience did not report a significant improvement of confidence for CAD (p=0.11), but all levels of experience showed an improved confidence to exclude HS (p<0.0001). The time to read CCTA exam decreased with availability of FFR-CT from 10.7±4.5 min to 8.4±3.8 min per case(p<0.0001).

CONCLUSION

CCTA with FFR-CT increased reader confidence to diagnose CAD and exclude HS. Interpretation of CCTA with FFR-CT reduced reading time. Change in reader confidence was observed to a greater degree with less experienced readers.

CLINICAL RELEVANCE/APPLICATION

CT based FFR improves reader confidence to diagnose coronary artery disease and reduces reading time.

SSA04-02 Endothelial Shear Stress (ESS) Measured from Coronary CT Angiography (CTA) Is Associated with Impaired Fractional Flow Reserve (FFR) Independently of Atherosclerotic Plaque Burden In Coronaries with Lesions of Intermediate Stenosis Severity

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PURPOSE

CTA plaque burden has recently been associated with lesion-specific ischemia. ESS modulates plaque progression and development of high-risk plaque features. It is also a key factor controlling flow-mediated dilation (FMD) to accommodate flow demands, such as in hyperemia. Thus, although pathobiology suggests a causal link of ESS to lesion-specific ischemia, their association has not been adequately explored to date. We assessed if ESS and plaque burden measured from CTA are associated with FFR<=0.8 in intermediate lesions.

METHOD AND MATERIALS

61 consecutive adults with clinically-indicated CTA and FFR in 90d in a 30-69% diameter stenosis (DS) lesion were retrospectively analyzed. Resting-state ESS was calculated from CTA using computational fluid dynamics (non-Newtonian blood, flow based on myocardial mass, flow distribution using Murray's law). Average ESS was measured in the 5mm proximal and distal to, and the 10mm around the center of each lesion for which FFR was measured. Plaque volume (%PV=% of wall tissue) in those vessels and lesion %DS were measured from CTA (Medis QAngio CT). Univariate logistic regression and receiver operating characteristic curve area (AUC) identified parameters associated with FFR<=0.8. Significantly-associated parameters were used in a multivariate model to determine independent association to FFR<=0.8.

RESULTS

25 lesions had FFR<=0.8 (41%). AUC to detect FFR<=0.8 was 0.62 for CTA %DS, 0.78 for %PV, and 0.70, 0.78 and 0.81 for proximal-, central-, and distal-to-lesion center ESS, respectively. In univariate analysis only %PV (p=0.02) and ESS were associated with FFR<=0.8 (p=0.02, 0.01, and 0.01). In multivariate analysis, ESS in the 5mm distal to the plaque center was independently associated with FFR<=0.8 (p=0.017). High ESS>5.4 Pa in that plaque location detected FFR<=0.8 with sensitivity, specificity, and overall accuracy of 77.3%, 76.9%, and 77%, respectively.

CONCLUSION

High resting ESS distal to the plaque center and plaque burden are associated with lesion-specific ischemia. We posit that high ESS and plaque burden affect FMD pathways, impairing a vessel's ability to dilate to accommodate hyperemic flow.

CLINICAL RELEVANCE/APPLICATION

ESS from rest CTA does not require simulating hyperemia and predicts lesion-specific ischemia (FFR<=0.8) independent of plaque burden, implying endothelial function is linked to inducible ischemia.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

SSA04-03 Association of Image and Lesion Characteristics to the Magnitude of the Deviation of a Novel, Open Fractional Flow Reserve (FFR) from Computed Tomography Angiography (CT-FFR) Technique from Gold-Standard Invasive FFR Measurements

Sunday, Nov. 26 11:05AM - 11:15AM Room: S504AB

Awards

Trainee Research Prize - Medical Student

Participants

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PURPOSE

Multiple CT-FFR techniques have been reported with excellent accuracy to detect hemodynamically significant lesions (invasive FFR<=0.8). However, limitations remain, with eg, the recent NXT trial excluding 13% of CTAs from FFRCT (HeartFlow) analysis solely due to image quality. We previously validated a CT-FFR algorithm that can be performed with or without a proprietary basis (RSNA 2016). We sought to assess whether image quality and lesion characteristics affect the diagnostic accuracy of this novel

CT-FFR algorithm.

METHOD AND MATERIALS

61 consecutive patients with clinically-indicated CTA and FFR in <90d in a vessel with 30-69% diameter stenosis by CTA were retrospectively analyzed. CT-FFR was calculated using a previously validated technique. We measured CTA (a) vascular signal-to-noise (SNR) and contrast-to-noise (CNR) from Housfield units in the aorta, coronary ostia, and proximal coronaries, (b) minimum vessel caliber (diameter, area) in and around the FFR-interrogated lesion, and (c) lesion location (proximal, mid, distal) and (d) lesion characteristics (calcified, complex, non-calcified). We assessed the relationship of independent variables (a)-(d) to dependent variables of (1) absolute difference between invasive FFR and CT-FFR (=FFR), and (2) binary determination of lesion significance (agreement of <=0.8 for CT-FFR and invasive FFR), using linear regression, t-test, ANOVA, chi-squared, and Fisher exact tests as appropriate.

RESULTS

Of the parameters tested, the following had significant associations: larger in-lesion minimum lumen area was correlated with reduced FFR (=-0.28; Std.Err.=0.11; p=0.03) and increased odds of binary decision agreement (=0.88; S.E.=0.42; p=0.04); larger vessel caliber proximal to the lesion was correlated with increased odds of binary agreement (=0.34; S.E.=0.13; p=0.01); and higher ascending aorta SNR was correlated with increased FFR (=0.26; S.E.=0.11; p=0.04).

CONCLUSION

In intermediate lesions, higher aorta SNR and smaller vessel caliber increase the absolute error of CT-FFR estimates, and smaller vessel caliber reduces agreement between CT-FFR<=0.8 and invasive FFR<=0.8. We posit the counter-intuitive loss of accuracy at higher SNR is due to increased contrast load obscuring the lumen vs calcified plaque

CLINICAL RELEVANCE/APPLICATION

Image quality and lesion characteristics may impact the diagnostic performance of CT-FFR for lesions of intermediate stenosis severity

SSA04-04 Non-invasive Rapid On-site Estimation of CT Angiography Derived Fractional Flow Reserve Using a Lumped Parametric Model: Initial Experience

Sunday, Nov. 26 11:15AM - 11:25AM Room: S504AB

Awards Student Travel Stipend Award

Participants

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PURPOSE

To investigate the feasibility and accuracy of a novel method to estimate fractional flow reserve (FFR) from coronary computed tomography angiography (CCTA) images based on lumped parametric models and to compare the accuracy of the new method to evaluation of degree of stenosis only.

METHOD AND MATERIALS

Twenty-five patients (36% female) who underwent CCTA and subsequent catheter based invasive FFR within 90 days were retrospectively selected. An FFR value <=0.8 was used to define functionally significant stenosis. Diagnostic performance of FFRct was evaluated and compared to performance of stenosis degree reported on CCTA. Invasively measured FFR served as the standard of reference in all subjects. For FFRct an observer, blinded for FFR outcome, extracted the coronary lumen semi-automatically using prototype software based on patient-specific lumped parameter models. Subsequently, location of FFRct was matched with catheter based FFR and FFRct was computed.

RESULTS

Catheter based FFR was performed in 39 coronary arteries and indicated significant stenosis in 16 arteries (12 patients). Analysis of stenosis degree on CCTA resulted in an area under the receiver operator curve (AUC) of 0.61 (95% confidence interval [CI]: 0.44-0.79) on a vessel basis and 0.55 (95%CI: 0.32-0.78) on a patient basis. A cutoff value of >50% to indicate significant stenosis resulted in sensitivity and specificity of 81% and 43% on a vessel basis and 83% and 23% on a patient basis. Use of FFRct improved performance substantially, with AUCs of 0.79 (95%CI: 0.65-0.93) and 0.82 (95%CI: 0.66-0.99), respectively. A cutoff value of <=0.8 resulted in sensitivity and specificity of 81% and 70% on a vessel basis and 92% and 69% on patient basis. Total runtime to calculate the FFRct value after completion of segmentation was <10 seconds.

CONCLUSION

Our preliminary results show that rapid on-site FFRct is feasible with high diagnostic performance and offers an incremental value over stenosis degree evaluation on CCTA alone for the detection of functionally significant stenosis. The method is fast, can be performed on-site and obviates the need for high computational power.

CLINICAL RELEVANCE/APPLICATION

Rapid on-site FFRct has the ability to increase the specificity of CCTA, thereby potentially reducing the number of patients unnecessarily referred for catheter based FFR.

SSA04-05 A Novel Quantitative CT Angiography Index: Based On the Amount of Myocardium Subtended By Stenosis and Minimal Lumen Diameter Correlates with Fractional Flow Reserve

Sunday, Nov. 26 11:25AM - 11:35AM Room: S504AB

Participants

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PURPOSE

To study the diagnostic performance of the ratio of Duke jeopardy score (DJS) to the minimal lumen diameter (MLD) at coronary computed tomographic angiography (CTA) for differentiating functionally significant between nonsignificant lesions, with reference to fractional flow reserve (FFR).

METHOD AND MATERIALS

Patients who underwent both coronary CTA and FFR measurement at invasive coronary angiography (ICA) within 2 weeks were retrospectively included in our study. DJS/MLDCT ratio, along with other parameters, including minimal luminal area (MLA), MLD, lesion length (LL), diameter stenosis, area stenosis, plaque burden, remodeling index, and quantitative coronary angiography (QCA) of lesions, were recorded. Lesions with FFRs <= 0.8 were considered to be functionally significant.

RESULTS

Seventy-two patients with 82 lesions were ultimately included for analysis. The LL, diameter stenosis, area stenosis, plaque burden, QCA, DJS and DJS/MLDCT ratio were all significantly longer or larger in the group of FFR <= 0.8 (p < 0.05 for all), while smaller MLA and MLD were also noted (p < 0.001 for both). ROC curve analysis determined the best cut-off value of DJS/MLDCT ratio as 2.04 (area under curve =0.866, 95 % confidence interval = 0.773-0.931), which yielded high diagnostic accuracy (84.1%, 69/82).

CONCLUSION

The DJS/MLDCT ratio, as characterized by using coronary CT angiography, correlates well with FFR measurements and is associated with the hemodynamically coronary stenosis.

CLINICAL RELEVANCE/APPLICATION

DJS/MLDCT ratio was an easy-to-calculate CT parameter and significantly higher in hemodynamically significant coronary lesions. DJS/MLDCT ratio has the best diagnostic performance compared to other traditional CT and invasive coronary angiography parameters. This novel index might help to non-invasively identify the hemodynamically significant lesions.

SSA04-06 The Effect of Sublingual Nitroglycerine on the Diagnostic Accuracy of Machine Learning-Based Coronary CT Angiography-Derived Fractional Flow Reserve

Sunday, Nov. 26 11:35AM - 11:45AM Room: S504AB

Participants

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PURPOSE

This study investigated the effect of sublingual nitroglycerine on the diagnostic accuracy of machine learning-based coronary CT angiography (CCTA)-derived fractional flow reserve (CT-FFR).

METHOD AND MATERIALS

This bi-centric retrospective investigation included 73 patients (61±12 years, 74% male) and 119 vessels from Europe and the United States. All patients had undergone a clinically indicated first or second generation dual-source CCTA study followed by invasive coronary angiography (ICA) with at least one invasive fractional flow reserve (FFR) measurement. Patients were divided into two groups (Gr): patients who were administered pre-CCTA sublingual nitroglycerine (Grnitro) and patients who were not administered any drugs prior to CCTA (Grnone). CCTA datasets were evaluated using an onsite, workstation-based machine learning CT-FFR prototype (Frontier, Siemens) to assess lesion-specific ischemia. Performance characteristics (accuracy, sensitivity, and specificity) and a receiver operating characteristics (ROC) analysis of the CT-FFR prototype to detect lesion-specific ischemia (defined as CT-FFR <=0.80) were evaluated in each group on a per-patient and per-lesion level, with invasive FFR as the reference standard.

The per-patient analysis in Grnitro and Grnone showed similar overall accuracy (87% vs. 89%), sensitivity (90% vs. 89%) and specificity (78% vs. 88%), respectively. The per-lesion analysis in Grnitro and Grnone also revealed similar accuracy (81% vs. 88%), sensitivity (82% vs. 93%) and specificity (80% vs. 85%), respectively. On a per-lesion level, the Area Under the ROC Curve (AUC) for CT-FFR Grnitro (0.85) and Grnone (0.88) showed similar discriminatory power for detecting lesion-specific ischemia with no statistical difference between the ROC curves (P=0.65).

CONCLUSION

This investigation revealed similar performance characteristics and discriminatory power for CT-FFR to detect lesion specific ischemia in patients who were and were not administered pre-CCTA sublingual nitroglycerine.

CLINICAL RELEVANCE/APPLICATION

Pre-CCTA nitroglycerine may not be an absolute requirement to ensure the accuracy of CT-FFR estimates for detecting lesionspecific ischemia. Ultimately accurate CT-FFR evaluations may thus be obtained in an expanded patient population and with a simplified workflow.

SSA04-07 Effect of Coronary Artery Calcium on the Diagnostic Performance of Machine Learning-Based Coronary CT Angiography-Derived Fractional Flow Reserve: Results from the Machine Registry

Sunday, Nov. 26 11:45AM - 11:55AM Room: S504AB

Participants

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PURPOSE

To investigate the effect of coronary artery calcium on the diagnostic performance of on-site machine learning coronary CT angiography (cCTA)-derived fractional flow reserve (CT-FFR).

METHOD AND MATERIALS

481 vessels in 314 patients (62.3+/-9.3 years, 74% male) who had undergone cCTA followed by invasive fractional flow reserve (FFR) measurement were enrolled in this sub-study of the MACHINE registry (Machine leArning based CT angiograpHy derIved FFR: a Multi-ceNtEr Registry). Coronary artery calcium was quantified using the Agatston convention. The diagnostic performance of a prototype deep machine-learning on-site CT-FFR algorithm (Frontier, Siemens) to detect lesion-specific ischemia was assessed across all Agatston score quartiles (Q1- Q4), in low to intermediate (Q1- Q3), and high Agatston scores (Q4) on a per-patient and per-vessel level with invasive FFR as the reference standard.

RESULTS

Median Agatston scores on a per-vessel and per-patient level were 76 (range 0-2066) and 238 (range 0-3920), respectively. The diagnostic accuracy of CT-FFR was superior to that of cCTA on a per-vessel (78% vs. 58%) and per patient (83% vs. 73%) level across all Agatston score quartiles. No statistically significant differences in diagnostic accuracy, sensitivity, or specificity of CT-FFR were observed across Agatston sore quartiles. CT-FFR demonstrated superior discriminatory power in vessels with high Agatston scores (250 to 2066) and low-intermediate Agatston scores (0 to 249) without a statistically significant difference in the area under the receiver-operating characteristic curve (AUC) (AUC: 0.77 [95%CI 0.68-0.86] vs. 0.86 [95%CI 0.82-0.90], p=0.76). CT-FFR showed incremental diagnostic power over cCTA alone (AUC 0.55 and AUC 0.66; both p<0.001) in vessels with high Agatston scores (AUC 0.77) and low to intermediate Agatston scores (AUC 0.86).

CONCLUSION

Machine learning CT-FFR demonstrated superior diagnostic performance over cCTA alone across all Agatston score quartiles both on a per-lesion and per-patient level with no difference between patients with low to intermediate and with high Agatston scores.

CLINICAL RELEVANCE/APPLICATION

CT-FFR has excellent diagnostic performance across all Agatston score quartiles which could facilitate its integration into clinical decision making trees for coronary artery disease management. This is of particular relevance in patients where cCTA specificity is impaired by heavy calcifications.

SSA04-08 Accuracy of Coronary Computed Tomographic Angiography to Detect Obstructive Coronary Artery Disease by Using Stress versus Rest Dataset in Patients Referred to Stress Computed Tomographic Perfusion

Sunday, Nov. 26 11:55AM - 12:05PM Room: S504AB

Participants

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PURPOSE

The combined evaluation with coronary computed tomographic angiography (CCTA) and stress computed tomographic perfusion (CTP) is emerging as a robust tool to provide anatomical and functional information in intermediate to high risk patients with suspected coronary artery disease (CAD). We sought to compare the diagnostic accuracy of CCTA to detect obstructive CAD between stress versus rest dataset as compared to invasive coronary angiography (ICA).

METHOD AND MATERIALS

Seventy-six consecutive symptomatic patients [mean age: 65 ± 9 years, male 64%] with intermediate to high pre-test probability of CAD and scheduled for clinically indicated ICA, were prospectively enrolled. All patients underwent rest-CCTA followed by stress-CTP protocol with adenosine (Revolution CT Scanner, GE Healthcare, Milwaukee, WI) with injection of 70 ml of Iodixanol 320 (Visipaque 320 mg/ml, GE Healthcare, Oslo, Norway). For both datasets, the image quality was evaluated with Likert score. The severity of coronary lesions was quantified in multi-planar curved reformatted images by identifying the minimum diameter and reference diameter for all stenoses, and the percentage of stenosis was derived according to the following formula: (Dref - Dmin)/Dref \cdot 100, where Dref is the reference diameter and Dmin is the minimum diameter. For CCTA and ICA, the obstructive CAD was defined as the presence of coronary artery stenosis>=50%.

RESULTS

Obstructive CAD was found in 61% (46/76) of patients at ICA. In a vessel-based model, the stress dataset showed a higher heart rate as compared to the rest dataset (76±14 vs 62±9 bpm, p<0.001) with similar image quality. The stress dataset showed similar sensitivity (95% vs. 93%) but slight lower specificity (75% vs. 80%, p:0.05] as compared to rest dataset. However, in both vessel and patient based model, stress and rest dataset showed similar area under the curve (AUC) (0.84 vs.0.82 and 0.84 vs. 0.84).

CONCLUSION

In static stress CTP, the new generation scanner allows to perform the coronary artery imaging in the stress dataset with the same accuracy of rest dataset. This preliminary evidence opens the potential scenario to perform a single stress acquisition providing anatomical and functional information without the need of additional scan.

CLINICAL RELEVANCE/APPLICATION

Our evidences open the potential scenario to perform a single stress CT acquisition providing anatomical and functional information without the need of additional scan.

SSA04-09 Coronary CT Angiography-Derived Fractional Flow Reserve for Therapeutic Decision Making

Sunday, Nov. 26 12:05PM - 12:15PM Room: S504AB

Awards

Student Travel Stipend Award

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PURPOSE

To investigate the performance of coronary CT angiography (cCTA) with cCTA-derived fractional flow reserve (CT-FFR) compared to invasive coronary angiography (ICA) with fractional flow reserve (FFR) for therapeutic decision-making in patients with suspected coronary artery disease (CAD).

METHOD AND MATERIALS

We retrospectively evaluated 74 patients (62.2±10.6 years, 62% male) with at least one coronary stenosis >=50% on clinically indicated dual-source cCTA who had subsequently undergone ICA with FFR measurement. CT-FFR values were computed using an on-site machine-learning algorithm (Frontier, Siemens) to assess the functional significance of CAD. The therapeutic strategy (optimal medical therapy alone versus revascularization) and appropriate revascularization procedure (percutaneous coronary intervention [PCI] versus coronary artery bypass grafting [CABG]) was selected using cCTA/CT-FFR. Accuracy and test characteristics for functionally significant CAD and therapeutic strategy selection based on cCTA/CT-FFR were calculated, with ICA/FFR-based findings and management as reference standards.

RESULTS

36 patients (49%) had functionally significant CAD based on ICA/FFR. cCTA/CT-FFR correctly identified functionally significant CAD and the need of revascularization in 35 of 36 patients (97%). When revascularization was deemed indicated, the same revascularization procedure (32 PCI and 3 CABG) was chosen in 35 out of 35 patients (100%). Overall, identical management strategies were selected in 73 of the 74 patients (99%).

CONCLUSION

cCTA/CT-FFR shows excellent performance to identify patients with and without need of revascularization and to select the appropriate revascularization strategy.

CLINICAL RELEVANCE/APPLICATION

cCTA/CT-FFR as a non-invasive "one-stop shop" has the potential to change diagnostic workflows and to directly inform therapeutic decision making in patients with suspected CAD.



KSNA° 2017

103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA05

Chest (Thoracic Malignancy/Lung)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S404CD



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

FDA Discussions may include off-label uses.

Participants

John P. Lichtenberger III, MD, Bethesda, MD (*Moderator*) Author, Reed Elsevier Beth Zigmund, MD, Haddonfield, NJ (*Moderator*) Consultant, BioVentrix, Inc

Sub-Events

SSA05-01 Radiologists vs Deep Learning System (3D Convolutional Neural Network): Radiological Prediction of Pathological Invasiveness in Lung Adenocarcinoma

Sunday, Nov. 26 10:45AM - 10:55AM Room: S404CD

Participants

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PURPOSE

To compare results of radiological prediction of pathological invasiveness(PI) in lung adenocarcinoma among three radiologists and deep learning system.

METHOD AND MATERIALS

This study included 90 patients (M:F=50:40) with 24 cases of adenocarcinoma in situ(AIS, PI=0mm), 20 cases of minimally invasive adenocarcinoma(IVA, PI>5mm). CT images with 0.625-mm thickness were evaluated. Three radiologists (R1, R2, R3; 7, 8, 25 years of experience) diagnosed each nodule by predicting PI from CT findings: irregular margin, air bronchiologram with disruption and/or irregular dilatation, pleural indentation, and solid component in part-solid nodule(size<=5mm or >5mm). In ground-glass nodule(GGN), a nodule density(dense or inhomogeneous) was evaluated. 3D Convolutional Neural Network (3D-CNN) was used as the deep learning system (DL, Tensorflow ver.0.12.1). Input data size from 3D CT images is 30x30x30 pixels(1601mm³). The 3D-CNN structure is constructed with 2 successive pairs of convolution and maxpooling layers, and 2 fully-connected layers. The output layer is composed of 3 nodes to recognize the 3 conditions (0=AIS,1=MIA/IVA). Repeated measures ANOVA and multivariate ROC analysis were used statistically.

RESULTS

90 nodules were 24 AISs(16GGNs, 8part-solids), 20 MIAs(3GGNs, 12part-solids, 5solids), and 46 IVAs(5GGNs, 20part-solids, 21solids). There were no significant differences in accuracy rates with or without PI among DL, R1, R2, and R3: 73.3%, 80%, 74%, and 83.3%. There were no significant differences in pathological diagnostic accuracy rates among DL, R1, R2, and R3: 51.1%, 61.1%, 53.3%, and 64.4%. Area under curves (AUC) of DL, R1, R2, R3 were 0.712(95% confidence intervals[CI], 0.61 to 0.80), 0.665(95%CI, 0.56 to 0.76), 0.574(95%CI, 0.47 to 0.68), and 0.714(95%CI, 0.61 to 0.80). AUCs of DL and R3 were significantly higher than R2 (p=0.039 and 0.026, respectively).

CONCLUSION

Despite small training data, DL showed accuracy rate almost equal to radiologists. AUC of DL was almost the same as the radiologist with much experience, which was significantly higher than the radiologist with small experience.

CLINICAL RELEVANCE/APPLICATION

Deep learning system can predict the PI in lung adenocarcinoma from CT images, resulting in being equal to radiologist with much experience.

SSA05-02 Preoperative Assessment of Parietal Pleural Invasion/Adhesion of Subpleural Lung Cancer: Advantage of Software-Assisted Analysis Using 4-Dimensional Dynamic-Ventilation CT

Sunday, Nov. 26 10:55AM - 11:05AM Room: S404CD

Participants

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PURPOSE

Using 4-dimensional (4D) dynamic-ventilatory scanning provided by a 320-row computed tomography (CT) scanner, we aimed to assess parietal pleural invasion and adhesion of peripheral (subpleural) lung cancer.

METHOD AND MATERIALS

Eighteen patients with subpleural lung cancer underwent both dynamic-ventilation CT during free breathing and conventional (static) chest CT as a preoperative assessment. Subsequently, the absence of parietal pleural invasion or adhesion was surgically confirmed in 13 patients, while the presence of parietal pleural invasion or adhesion was surgically confirmed in five patients. Two chest radiologists, who were blinded to patient status, cooperatively evaluated the presence of pleural invasion/adhesion on the chest CT by two different methods: (i) observing conventional (static) high-resolution CT images, reconstructed in the axial, coronal, and sagittal directions; and (ii) observing 4D dynamic-ventilation CT images combined with a colored map created by research software that suggested the absence/presence of pleural invasion/adhesion based on the difference in the movements between the lung surface and chest wall. The parameters of diagnostic accuracy were assessed including a receiver operating characteristic analysis.

RESULTS

For the assessment of pleural invasion/adhesion, observing the software-assisted 4D dynamic-ventilation CT images achieved perfect diagnostic accuracy (sensitivity, 100%; specificity, 100%; area under the curve [AUC], 1.000), in comparison with observing the conventional chest CT (sensitivity, 60%; specificity, 77%; AUC, 0.846).

CONCLUSION

Software-assisted 4D dynamic-ventilation CT can be utilized as a novel imaging approach for accurate preoperative analysis of pleural invasion/adhesion of peripheral lung cancer.

CLINICAL RELEVANCE/APPLICATION

This is the first study to show the clinical utility of software-aided, 4D dynamic-ventilation CT images for the preoperative diagnosis of parietal pleural invasion/adhesion of subpleural lung cancer.

SSA05-03 Reduction of TNM Misstaging in Routine FDG-PET/CT Reports of NSCLC Patients Using Computer-Aided Standardized Label Segmentation

Sunday, Nov. 26 11:05AM - 11:15AM Room: S404CD

Participants

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PURPOSE

FDG-PET/CT is the diagnostic standard procedure for staging of NSCLC patients. To date, most hospitals create free-style reports that do not necessarily contain all staging-relevant information. This may lead to misstaging and subsequently erroneous treatment planning. Therefore, we extracted the TNM staging formula from previous free-style PET/CT reports (RIS Stage) and compared these with a segmentation-based approach.

METHOD AND MATERIALS

First, the reports from 145 patients who underwent FDG-PET/CT for primary staging of NSCLC at the University Hospital Basel were extracted from the RIS and TNM (7th edition) stage was determined according to the text information by an experienced radiology and nuclear medicine physician. Next, the corresponding PET and CT image datasets were downloaded from the PACS and transferred to a 3D-slicer-based prototype software that allows for a manual segmentation of tumors, lymph nodes and metastasis using a full set of labels including location information and morphological TNM features.

RESULTS

In a substantial number of patients, not enough information was provided by the report to extract a distinct TNM stage: T: 18.6% (27/145); N: 10.3% (15/145); M: 2.1% (3/145). TNM information could be extracted in all patients with the segmentation-based approach. Furthermore, in 29 cases, there was a considerable discrepancy between the report and annotation: upstaging due the annotations: T: n = 11, N: n = 6, M: n = 4; downstaging due the annotations: T: n = 3; N: n = 4; M: n = 1.

We could demonstrate that the proper TNM stage could not be derived from unstructured PET/CT reports in a roughly 30% of the cases . This commonly affects the T-stage because of missing diameter measurements, but also N and M stage. Our approach with tumor labels allows for a clear definition of cancerous lesions in a standardized and reproducible manner.

CLINICAL RELEVANCE/APPLICATION

Labels generated using the proposed approach can be directly translated into clinical decision making such as tumor boards and are less prone to interpretation.

SSA05-04 Computer-Aided Volumetry of the Three-Dimensional Solid Component Size in Part-solid Lung Cancer: Correlation with Prognosis

Sunday, Nov. 26 11:15AM - 11:25AM Room: S404CD

Participants

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PURPOSE

According to the TNM classification of the eighth edition of the UICC, the T factor of a ground-glass nodule is regulated by the size of the solid component within the tumor. The purpose of this study was to investigate the correlation between the postoperative prognosis of patients with part-solid lung cancer and the solid component size acquired using computer-aided three-dimensional (3D) volumetry software on thin-section multi-detector computed tomography (MDCT) images.

METHOD AND MATERIALS

We retrospectively reviewed preoperative MDCT data, surgical records, pathological reports, and postoperative follow-up data of patients with primary lung cancer with ground-glass opacity at our institution from 2013 to 2016, and a total of 92 patients (47 men and 45 women; mean age 66 years) were selected for evaluation. All MDCT data of 0.5-mm thickness were transferred to a 3D workstation, and a chest radiologist measured the maximum solid component size on an axial image (2D-SS) and the 3D maximal solid component size on a multiplanar reconstructed image (3D-SS) within the part-solid nodules. Furthermore, the 3D solid volume (3D-SV) within the nodules was measured using semi-automatic volumetry software. Correlations with postoperative recurrence and disease-free survival (DFS) were compared by receiver operating characteristic (ROC) analysis and a Cox proportional hazards model to assess the predictive values of 2D-SS, 3D-SS, and 3D-SV for prognosis.

RESULTS

For the prediction of postoperative recurrence, the area under the ROC curve was 0.781 for 2D-SS, 0.748 for 3D-SS, and 0.823 for 3D-SV (all p<0.001). The optimal cutoff value for 3D-SV for predicting tumor recurrence was 590 mm3, with a sensitivity of 0.923 and specificity of 0.747. According to the multivariate Cox proportional hazards model, the only significant predictive factor for DFS was a 3D-SV > 590 mm3 (hazard ratio 6.03, p<0.001).

CONCLUSION

The measurement of 3D-SV using computer-aided 3D volumetry software predicted the postoperative prognosis of patients with part-solid lung cancer more accurately than did 2D-SS or 3D-SS.

CLINICAL RELEVANCE/APPLICATION

3D computer-aided volumetry of primary lung cancer will lead to more accurate prognostic predictions compared with tumor diameter measurement on 2D images, especially for part-solid lung cancer.

SSA05-05 Prediction of the Invasive Component of Lung Adenocarcinoma with Software Segmentation of the Solid Component in Subsolid Nodules: Value of the Vessel Removal Algorithm

Sunday, Nov. 26 11:25AM - 11:35AM Room: S404CD

Participants

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PURPOSE

The relationship between the invasive component of lung adenocarcinomas and the solid component of subsolid nodules on CT has been well established. This study aimed to evaluate the value of a vessel removal algorithm in segmentation of subsolid nodules by comparing the measurements of the solid component on CT with the measurement of the invasive component on pathology in lung adenocarcinomas manifesting as subsolid nodules.

METHOD AND MATERIALS

Among 283 cases of surgically resected lung adenocarcinomas, 73 cases which manifested as subsolid nodules on thin-section CT and had the invasive component of ≤ 10 mm on pathology were selected for analyses. For each nodule, semi-automated segmentation was performed by 2 radiologists and 3D longest, axial longest and effective diameters of solid component were

measured before and after using a vessel removal tool. These measurements were compared with the invasive component diameter on pathology using the paired t-test and Pearson's correlation test.

RESULTS

After removing cases with insufficient segmentation, 68 subsolid nodules were included for statistical analysis. The mean maximal diameter of the invasive component on pathology was 4.6 mm (range, 0 - 10 mm). The correlation between software and pathology measurements was significant (p<0.01) and the correlation after vessel removal (r= 0.49 to 0.54) was better than before vessel removal (r=0.27 to 0.41). The mean measurement difference between solid component on CT and invasive tumor on pathology ranged from 0.73 mm to 2.44 mm before vessel removal and from -1.05 mm to 0.10 mm after vessel removal. The smallest mean measurement difference was obtained with 3D longest diameter of solid component after vessel removal in both readers (-0.26 mm to 0.10 mm), with no significant difference from pathology (p=0.53-0.83).

CONCLUSION

By adding a vessel removal algorithm in software segmentation of subsolid nodules, the prediction of invasive component in lung adenocarcinomas can be improved.

CLINICAL RELEVANCE/APPLICATION

Removing pulmonary vessels in segmenting subsolid nodules on CT may lead to a better prediction of the invasive component on pathology and therefore to a better management of such nodules.

SSA05-06 Clinical Application of Quantitative Dual-Energy CT Iodine Maps and CT Morphologic Features in Distinguishing Small Cell Lung Cancer from Non-Small Cell Lung Cancer

Sunday, Nov. 26 11:35AM - 11:45AM Room: S404CD

Participants

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PURPOSE

To evaluate prospectively the clinical usefulness of quantitative dual-energy CT (DECT) iodine enhancement metrics combined with morphological CT features in distinguishing small cell lung cancer (SCLC) from non-small cell lung cancer (NSCLC).

METHOD AND MATERIALS

106 consecutive untreated patients (76 men, 30 women; mean age, 61.1 years \pm 9.5) were enrolled and underwent DECT before biopsy. A total of 28 conventional CT descriptors were assessed. DECT metrics including Iodine density, iodine ratio and normalized iodine uptake were measured. Multiple logistic regression analyses were applied to identify independent factors of lung cancer subtypes. Two areas under the receiver operating characteristic curve (ROC) were compared.

RESULTS

Histology revealed adenocarcinoma in 44, squamous cell carcinoma (SCC) in 36 and small cell lung cancer (SCLC) in 26 patients. SCLCs were found more frequently in larger (P=0.014) and centrally located (P=0.012) tumors, tumors with homogeneous enhancement (P=0.044), lymphadenopathy (P=0.038), confluent mediastinal lymphadenopathy (P<0.001), encasement of mediastinal structures(P=0.004), vascular involvement (P=0.005), lung atelectasis and/or obstructive pneumonia (P=0.019) and lower iodine density, iodine ratio and normalized iodine uptake (all Ps<0.01).NSCLCs were more likely to be with spiculation (P=0.005), vascular convergence (P=0.011), thickened adjacent bronchovascular bundles (P=0.017), and pleural retraction (P=0.005).The significantly independent prognostic factors of SCLC were larger tumor size, central location, confluent mediastinal lymphadenopathy, homogeneous enhancement, lower iodine ratio and normalized iodine uptake, and without coarse spiculation when adjusting for pleural retraction and lung atelectasis and/or obstructive pneumonia. ROC curve analysis indicated that use of CT features combined with DECT metrics (area under the ROC curve, AUC =0.981) was significantly superior to use of CT features alone (AUC = 0.908) (P=0.007).

CONCLUSION

Quantitative iodine-enhanced metrics generated from DECT in combination with CT features can be used to distinguish SCLC from NSCLC better than use of CT features alone.

CLINICAL RELEVANCE/APPLICATION

DECT can provide both quantitative iodine-enhanced metrics and CT features for discrimination of SCLC from NSCLC and is recommended for clinical use to help initial planning of lung cancer management.

SSA05-07 Comparison of the FDG-PET Avidity of Benign and Malignant Pure Ground Glass Opacities (GGOs): Is Higher FDG-PET Uptake More Typical of Benign GGOs?

Sunday, Nov. 26 11:45AM - 11:55AM Room: S404CD

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PURPOSE

To determine whether 2-[fluorine-18] fluoro-2-deoxy-d-glucose (FDG) PETuptake is higher in benign or malignant GGOs.

METHOD AND MATERIALS

1013 of 2544 total diagnostic PET-CT scans performed in 2011 were randomly selected and retrospectively reviewed to assess for pure GGOs with a mean diameter > 1 cm. 59 GGOs were identified by image review in 40 patients (21F, 19M, mean age 62 yrs, range 22-85 yrs), with a mean of 1.5 GGO per patient, range 1-5. Two observers, blinded to PET findings and final diagnosis, independently reviewed the CT images with respect to location, size, and attenuation (mean Hounsfield units) of GGOs. A third observer, blinded to final diagnosis, analyzed the PET images. A region-of-interest (ROI), inclusive of the entire GGO, was used to measure the maximum standardized uptake value (SUVmax). Final diagnosis of malignancy was made based on pathology, if available, or upon increased size and attenuation; final diagnosis of benignity was made if the GGO resolved, was new compared to a scan performed within the last 3 months, or was stable for at least 60 months; otherwise the GGO was considered indeterminate. The benign and malignant GGOs were compared using a 2-tailed Student's t test.

RESULTS

3 of 59 GGOs were excluded due to less reliable SUV measurements (proximity to adjacent FDG-avid structures). Of the remaining 56 GGOs, 15 GGOs were indeterminate, resulting in a cohort of 41 pure GGOs, 31 benign and 10 malignant. Benign GGOs were significantly larger than malignant ones (average mean diameter 26 mm versus 14 mm, respectively) (p=0.04). The SUVmax was higher in the benign group (mean 2.2; median 1.3; range 0.4-8.8) than the malignant group (mean 0.8; median 0.8; range 0.5-1.4) (p=0.05). With an SUVmax threshold to ensure 100% sensitivity for detection of malignancy, the specificity for the detection of malignancy was 39%. There was no significant difference in mean attenuation (p=0.4).

CONCLUSION

Benign pure GGOs had higher FDG-PET uptake than malignant GGOs. At an SUVmax threshold ensuring 100% sensitivity for malignancy, 39% of benign GGOs could avoid misinterpretation as malignant lesions.

CLINICAL RELEVANCE/APPLICATION

This study shows that higher FDG PET-uptake is much more typical of benign, than malignant, pure GGOs. Awareness of this finding should improve PET-CT interpretation of GGOs and resultant clinical management.

SSA05-08 Histologic Subtypes Are Not Associated with the Presence of Sarcopenia in Lung Cancer

Sunday, Nov. 26 11:55AM - 12:05PM Room: S404CD

Participants

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PURPOSE

Sarcopenia is prevalent and a known adverse prognostic effector in lung cancer (LCA). However, the relationship between sarcopenia and histology remains uncertain in LCA.

METHOD AND MATERIALS

Consecutive patients with newly diagnosed LCA (n=778) between June 2012 and February 2015 were retrospectively reviewed to identify factors associated with sarcopenia. Sarcopenia was defined as CT-determined L3 muscle index (muscle area at L3/height2) of < 55 cm2/m2 for men and < 39 cm2/m2 for women.

RESULTS

Mean patient age was 67.7 ± 10.8 years, and most (73.1%) were male. The most prevalent histology was adenocarcinoma (44.0%) and 71.6% of patients had stage III or IV disease. The overall prevalence of sarcopenia was 48.2% (60.3% in men, and 15.3% in women). Univariable analysis showed sarcopenia was significantly associated with male gender, age (>= 65 years), smoking status, lower BMI (< 23 kg/m2), advanced stage (III and IV), and high comorbidity score (Charlson index >= 3). Furthermore, the prevalence of sarcopenia was higher in squamous cell carcinoma (54.9%) and small cell LCA (56.4%) than in adenocarcinoma (39.8%). Multivariable analyses showed sarcopenia was independently associated with a male gender (odds ratio [OR], 11.13), elderly (OR, 2.02) and low BMI (OR, 6.28), stage IV (OR, 1.98), and high comorbidity (OR, 1.93). However, no significant association was found between histologic subtypes and sarcopenia.

CONCLUSION

In a single center lung cancer cohort, sarcopenia was found to be significantly associated with old age, male gender, an advanced stage, comorbidities, and low BMI in LCA. However, histology subtype was not an independent factor for the presence of sarcopenia.

CLINICAL RELEVANCE/APPLICATION

Understanding of associated factors of sarcopenia might provide better understanding of the mechanism responsible for cancer cachexia in lung cancer.

SSA05-09 Imaging Features Associated with Spread through Air Spaces (STAS) in Patients with Lung Adenocarcinoma

Sunday, Nov. 26 12:05PM - 12:15PM Room: S404CD

Awards

Student Travel Stipend Award

Participants Seon Kyoung Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose Tae Jung Kim, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Spread through air spaces (STAS) is a recently recognized pattern of tumor invasion and has been reported to be a predictor of recurrence and survival in lung adenocarcinomas (ADCs). However, there has been no detailed investigation on imaging-based identification of STAS in lung ADC. We aimed to explore the imaging features for predicting STAS in surgically resected lung ADCs.

METHOD AND MATERIALS

Presence of STAS was evaluated in 1,295 surgically resected ADCs from April 2015 to December 2016. STAS-positive and STASnegative patients were matched 1:2 using patient variables (e.g.: age, sex and smoking status). CT morphologic features (solidity, location, margin, shape, cavity, calcification, central low-attenuation, ill-defined opacity around the tumor, air-bronchogram, satellite lesion, pleural retraction, and percentage of solid portion), and FDG uptake on PET were analyzed by using multivariate logistic regression and receiver operating characteristics (ROC) curve.

RESULTS

STAS was found in 127 (9.7%) of 1295 patients. Ninety-six STAS-positive patients and 188 STAS-negative patients after matching were included in the analyses. STAS was found more frequently in solid tumors (75 of 96, 78.1%) than part-solid (21 of 96, 21.9%) or ground-glass nodules (0 of 96, 0%) (P<0.001). STAS was also found to be associated with central low-attenuation, ill-defined opacity around the tumor, percentage of solid portion and FDG uptake (P<0.001, respectively). Percentage of solid portion was unique independent predictor for the presence of STAS (OR 1.061, 95% C.I. 1.039-1.085) and cut-off value of 90.8% showed good discriminatory power with a sensitivity of 89.6% and a specificity of 61.2%.

CONCLUSION

Percentage of solid portion on CT appears to be a promising imaging biomarker for predicting STAS in lung ADCs, potentially allowing proper management.

CLINICAL RELEVANCE/APPLICATION

CT imaging features of lung ADC can be used to identify the presence of STAS and may help clinicians make better decisions about the exact extent of surgical resection or radiation therapy.







SSA06

Science Session with Keynote: Emergency Radiology (Cutting Edge Technologies)

Sunday, Nov. 26 10:45AM - 12:15PM Room: N226



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

Participants

Karen S. Lee, MD, Boston, MA (*Moderator*) Nothing to Disclose Michael N. Patlas, MD, FRCPC, Hamilton, ON (*Moderator*) Nothing to Disclose Zachary S. Delproposto, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose

Sub-Events

SSA06-01 Emergency Radiology Keynote Speaker: Machine Learning in Emergency Neuroradiology

Sunday, Nov. 26 10:45AM - 10:55AM Room: N226

Participants

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SSA06-02 Improved Detection and Confidence of Subtle Lung Lesion Using Bone Suppression Imaging Generated By Deep Learning Algorithm in the Emergency Department

Sunday, Nov. 26 10:55AM - 11:05AM Room: N226

Participants

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PURPOSE

To determine whether a standard radiograph aided by the bone suppression imaging (BSI) using deep learning algorithms could improve the radiologists' performance for detection of subtle lung lesions in the emergency department (ED).

METHOD AND MATERIALS

This retrospective study included 160 patients who underwent digital chest radiographs and chest CT in the ED: 80 patients with 227 subtle lung lesions and 80 patients without lung lesion with reference to CT from October, 2016 to March, 2017. Deep learning-trained algorithm, which was based on a state-of-the-art convolutional neural network, was applied to the standard radiographs to create corresponding bone suppression imaging. Eight observers (4 board-certified radiologists and 4 radiology residents) rated their confidence level regarding the presence or absence of subtle lung lesions in two reading sessions with an interval or more than 2 weeks: First, each patient image was evaluated with standard radiographs, and then rerandomized images were read with standard radiographs plus BSI. On a per-lesion basis, receiver operating characteristic (ROC) analysis, sensitivity, specificity, and diagnostic confidence were used to evaluate observer performance.

RESULTS

The average area under the ROC curve (AUC) for all observers was improved from 0.594 with standard radiographs to 0.621 with additional BSI (p = 0.282). The sensitivity significantly increased from 0.224 unaided to 0.300 aided by BSI (p < 0.001); the specificity significantly decreased from 0.993 to 0.989 (p = 0.004). The average diagnostic confidence level with additional BSI significantly increased than that with standard radiographs for all readers except one board-certified radiologist (p < 0.001).

CONCLUSION

The use of bone suppression imaging improves the radiologist's performance in the detection of subtle lung lesions on digital chest radiography.

CLINICAL RELEVANCE/APPLICATION

The clinical application of the deep learning-trained algorithm such as bone suppression imaging could helpful in the detection of subtle lung lesions.
SSA06-03 Workflow Evaluation of a New Fully Automated Dual-Energy CT Post-Processing Configuration

Sunday, Nov. 26 11:05AM - 11:15AM Room: N226

Participants

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PURPOSE

To evaluate workflow implications of fully automated Dual Energy CT post-processing on image availability and series timing.

METHOD AND MATERIALS

In our existing DECT post-processing workflow, source high and low kVp datasets are transmitted to a thin-client server (Syngo Via software version VB10, Siemens, Forchheim Germany). For contrast-enhanced abdomen and pelvis CT scans, technologists have been instructed to create axial and coronal iodine overlay and matching virtual non-contrast images for transmission to PACS. We installed a pre-release trial software version (Syngo Via VB20) that simultaneously receives the source datasets, and we configured the server to automatically create and transmit the same DECT series to PACS without user interaction. For the first 95 consecutive contrast enhanced ED abdomen and pelvis CT scans performed immediately after server configuration between 03/23/17 - 03/31/17, we recorded presence of manually and automatically created DECT series in PACS, and the series times (when the final image in the series was created) from the DICOM header for: The DECT source dataset, the last manually processed DECT series, and the last routine image series created by the technologist on the scanner console.

RESULTS

Presence of DECT post-processed image series increased from 23% to 92% between the manual and automated workflows. Median intervals from source image creation to DECT series creation were 18 min manual and 1 min automated. All of the 22 manually processed DECT series were created after the last scanner console series, while 97% (83/86) of the automated DECT series were created before the technologists had finished their work on the console.

CONCLUSION

Incorporation of a fully automated DECT post-processing workflow eliminates additional steps from the technologists, resulting in a marked increase in the proportion of scans containing the desired DECT image series, and a large reduction in processing delays. The proportion of processed scans with DECT images created before the final scanner console reconstruction rises from 0% to 97%, so that DECT post-processing is no longer the rate limiting step in exam completion.

CLINICAL RELEVANCE/APPLICATION

Incorporation of a fully automated Dual Energy CT post-processing workflow has the potential to eliminate barriers that commonly prevent practices from incorporating Dual Energy CT into their clinical routine.

SSA06-04 Optimizing CT Radiation Dose with Model-Based Iterative Reconstruction in Diagnosing Acute Appendicitis

Sunday, Nov. 26 11:15AM - 11:25AM Room: N226

Participants

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PURPOSE

To determine CT radiation dose as low as reasonably achievable in diagnosing appendicitis using model-based iterative reconstruction (IR).

METHOD AND MATERIALS

The institutional review board approved this prospective study and informed consent was obtained from each participant. The study protocol was registered to ClinicalTrials.gov (NCT02556983). We included 30 patients (mean age, 27.2 ± 7.6 years; 17 females) undergoing 2-mSv CT for suspected appendicitis. With raw data of original 2-mSv CT scans, CT scans simulating lower doses of 1.5 mSv, 1.0 mSv and 0.5 mSv were generated, using a low-dose simulation tool and the IR. Three step-wise non-inferiority tests were planned, where diagnostic performance of 1.5-mSv, 1.0-mSv and 0.5-mSv CT to 2.0-mSv CT were sequentially compared. Non-inferiority test for the next lower dose was performed only when the prior, higher dose passed the non-inferiority test. The primary endpoints were the pooled area under the curve (AUC) in the receiver operating characteristic analysis in diagnosing appendicitis, for three abdominal radiologists and three non-abdominal radiologists. Non-inferiority was established when the upper bound of the two-sided 95% confidence intervals (CI) for the difference of the pooled AUC lay below the non-inferiority margin, which was predetermined to be 0.06.

For abdominal radiologists, the non-inferiority of 1.5, 1.0, and 0.5-mSv CT to 2.0-mSv CT was sequentially accepted (the difference of 1.5-mSv CT to 2.0-mSv, 0.007 [95% CI, -0.016-0.030]; that of 1.0-mSv CT, 0.003 [95% CI, -0.037-0.044]; that of 0.5-mSv, 0.017 [95% CI, -0.016-0.050]). For non-abdominal radiologists, the non-inferiority of 1.5 and 1.0-mSv CT was sequentially accepted (the difference of 1.5-mSv CT, -0.031 [95% CI, -0.101-0.038]; that of 1.0-mSv CT, -0.017 [95% CI, -0.070-0.035]) but that of 0.5-mSv CT was failed to be proven (the difference of 0.5-mSv, 0.045 [95% CI, -0.071-0.161]).

CONCLUSION

With model-based IR, 0.5-mSv CT showed non-inferior diagnostic performance to 2.0-mSv CT for expert abdominal radiologists. For non-abdominal radiologists, 1.0 mSv was the lowest achievable dose to maintain the diagnostic performance.

CLINICAL RELEVANCE/APPLICATION

Considering the high prevalence of appendicitis and clinical settings where expert radiologists are often unavailable, 1-mSv could be regarded as an acceptable dose in diagnosing appendicitis.

SSA06-05 Dual Energy CT for Routine Imaging of the Abdomen and Pelvis in the ER: Radiation Dose and Image Quality

Sunday, Nov. 26 11:25AM - 11:35AM Room: N226

Participants

Jeremy R. Wortman, MD, Boston, MA (*Presenter*) Nothing to Disclose Jennifer W. Uyeda, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Aaron D. Sodickson, MD, PhD, Boston, MA (*Abstract Co-Author*) Institutional Research Agreement, Siemens AG; Consultant, Bayer AG

PURPOSE

To determine if dual energy CT (DECT) of the abdomen and pelvis can be performed routinely in the Emergency Department setting with acceptable image quality and radiation dose.

METHOD AND MATERIALS

The study cohort included 40 consecutive single energy portal venous phase contrast enhanced CT (SECT) scans of the abdomen and pelvis, which were compared with 40 consecutive portal venous phase DECT scans of the abdomen and pelvis performed after DECT implementation. All scans were performed on the same scanner (Siemens SOMATOM Definition Flash), and all were reconstructed with iterative reconstruction (SAFIRE, strength 3) with a soft tissue kernel. For each scan, the following data was gathered: demographic variables including age and gender; patient size measurements including weight and effective diameter; scan parameters including kVp, contrast volume injected, contrast agent, pitch, scan time, reference mAs and reconstruction kernel; and radiation dose metrics including CTDIvol and DLP. For each scan, measurements of objective image quality were made including signal, noise, and signal to noise ratio (SNR) of the aorta, main portal vein, liver, spleen, and psoas muscle, as well as noise measurements of retroperitoneal fat and air. Categorical variables were compared between groups with a chi-square test and continuous variables were compared with a t-test.

RESULTS

There was no significant difference between the SECT and DECT cohorts in demographic variables or patient size. Mean CTDIvol was significantly lower with DECT than SECT (10.8 mGy vs. 16.6 mGy, p < 0.0001), as was mean DLP (532.3 mGy*cm vs. 757.9 mGy*cm, p = 0.002). SNR was significantly higher in the DECT compared with the SECT group for the aorta (13.7 vs. 11.5, p = 0.02), main portal vein (14.5 vs. 11.9, p = 0.006), liver (11.3 vs. 9.8, p = 0.04), and spleen (12.1 vs 9.8, p = 0.005); there was no significant difference between groups in SNR of the psoas, or in noise measurements of retroperitoneal fat and air.

CONCLUSION

Dual energy CT can be performed for routine imaging of the abdomen and pelvis in the Emergency Department setting at a lower radiation dose than single energy CT, with a significant increase in many measures of objective image quality.

CLINICAL RELEVANCE/APPLICATION

Dual Energy CT of the abdomen and pelvis can be performed routinely in Emergency Department patients, with preserved image quality and radiation dose.

SSA06-06 Dual Energy/Spectral CT Utilization Rates in the Emergency Radiology Department: Does DECT Add Clinical Value in the Acute Setting?

Sunday, Nov. 26 11:35AM - 11:45AM Room: N226

Participants

Mohammed F. Mohammed, MBBS, Vancouver, BC (*Presenter*) Speaker, Siemens AG; Employee, X-Ray Teleradiology Services Khaled Y. Elbanna, MBChB, FRCR, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Michael C. Shao, BSC, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Shamir Rai, MD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Tim O'Connell, MD, Meng, Vancouver, BC (*Abstract Co-Author*) President, Resolve Radiologic Ltd; CEO, Emtelligent Software Ltd; Speaker, Siemens AG Patrick D. McLaughlin, FFR(RCSI), Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Luck J. Louis, MD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Faisal Khosa, FFR(RCSI), FRCPC, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose Savvas Nicolaou, MD, Vancouver, BC (*Abstract Co-Author*) Institutional research agreement, Siemens AG

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Several papers have been published in recent years on the potential of Dual Energy CT (DECT) applications and how they may add clinical value to routine CT studies. Our study assessed the utilization rates of DECT in the emergency radiology department of a tertiary care hospital and level I trauma center and the clinical value added by dual energy interrogation methods.

METHOD AND MATERIALS

For this retrospective, IRB-approved study, the hospital RIS was queried for all DECT scans performed in the emergency department between January 1, 2016 to December 31, 2016. A total of 3159 DECT were performed and were included in our study. The studies were divided by organ system and the reports were reviewed by Emergency Radiology staff, fellows and residents for mention of DE/spectral interrogation as part of the interpretation of the study. Note was made of the number of times DE/spectral interrogation techniques altered management (by changing the diagnosis or detection of an unexpected, clinically relevant finding), confirmed an observation and increased confidence in the definitive diagnosis, provided additional relevant information or characterized an incidental finding - thus avoiding the need for further investigation.

RESULTS

DE/spectral analysis was utilized in 1497 studies out of 3159 (47.39 %). Utilization rates were highest for the musculoskeletal system (97.8 %) followed by the spine (26.3 %), abdomen and pelvis (19.6 %), head (13 %) and chest (11.8 %). DE/spectral analysis altered management in a significant way 14.7 % of all cases, confirmed suspected observations and increased diagnostic confidence in 13 % of cases, provided relevant information on an observation in 5.7 % of cases and characterized an incidental finding in 1.4 % of all cases.

CONCLUSION

There is a high utilization rate of dual energy analysis in the acute setting, with close to half of all DECT studies undergoing DE interrogation. DE/spectral analysis frequently adds value to the examination by providing information that would have otherwise required additional imaging or other investigations.

CLINICAL RELEVANCE/APPLICATION

Routine utilization of DE/spectral techniques can impact management, improve diagnostic confidence and provide definitive clinically relevant diagnostic information only capable by DECT/spectral techniques.

SSA06-07 Increasing Acuity of ED Patients: An Opportunity for Emergency Radiology

Sunday, Nov. 26 11:45AM - 11:55AM Room: N226

Participants Jason W. Motkoski, MD,BSC, Vancouver, BC (*Presenter*) Nothing to Disclose Luck J. Louis, MD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Faisal Khosa, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose John R. Mayo, MD, Vancouver, BC (*Abstract Co-Author*) Speaker, Siemens AG Savvas Nicolaou, MD, Vancouver, BC (*Abstract Co-Author*) Institutional research agreement, Siemens AG Sabeena Jalal, MBBS,MSc, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Chad Kim Sing, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose David Evans, MD, FRCPC, Vancouver, AB (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Single payer health systems have adapted 24/7 Emergency Radiology services at a rate lower than that of competitive multiple payer systems. We conducted a 10-year review of 2.3 million patients in our health region to establish whether or not there is increasing opportunity for Emergency Radiology to improve patient care. We focused on demographic differences that may account for heterogeneous access to 24/7 Emergency Radiology.

METHOD AND MATERIALS

We conducted a 10-year multi-centre review of 2.3 million patient encounters in Emergency Departments across our health region. For each encounter, we noted the presenting hospital, calendar year, acuity of patient presentation (based on the CTAS scale, from 1 - most acute to 5 - least acute) and overall patient length of stay. Trends in these parameters were evaluated longitudinally among individual hospitals and comparisons made to averages across the entire health region for specific calendar years.

RESULTS

There has been a significant increase in average acuity of patients presenting to EDs across our health region during the study period (2007-2017). In 2007, 51% of patients presenting to all EDs were considered "acute" by CTAS standards (CTAS 1, 2 or 3) and this increased to an average of 57% in 2017. During this time, our quaternary referral hospital, where 24/7 Emergency Radiology has already been implemented), consistently demonstrated the highest proportion of acute patients, ranging from 58% in 2007 to 68% in 2017. Interestingly, over the study period, there has been a significant increase in acuity of patients presenting to rural hospitals, from 34% in 2007 to 64% in 2017. This may be attributable to increased rates of Trauma.

CONCLUSION

There has been a systematic increase in acuity of patient presentations to EDs at all hospitals in our health region over the past 10 years, creating an opportunity for increased utilization of 24/7 Emergency Radiology services. Interestingly, the highest rate of increase has been in rural hospitals, which now rival our quaternary centre for proportion of acuity, and solutions to meet these patient needs within the confines of our single payer system may be needed.

CLINICAL RELEVANCE/APPLICATION

Increased acuity of patient presentations to EDs across our health region, and particularly in rural areas, has created an environment where 24/7 Emergency Radiology may add clinical value in our single payer health system.

SSA06-08 The Emergency Department and Abdominal Imaging: Quantitative Analysis of the Level of Readability of Online Patient Education Resources

Sunday, Nov. 26 11:55AM - 12:05PM Room: N226

Participants

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PURPOSE

The widespread availability and ease of access has made the Internet a major source of healthcare information for patients. As per the American Medical Association (AMA), the average American reads at an 8th grade level, and to account for patient diversity, the AMA and National Institutes of Health (NIH) guidelines recommend that consumer healthcare websites be written between a 3rd and 7th grade level. The purpose of this study is to evaluate the level of readability of patient education websites, written for the lay public, pertaining to common abdominal imaging diagnoses and diagnostic test performed in the emergency room.

METHOD AND MATERIALS

Thirteen search terms were Googled and the top 10 links for each term were collected and individually analyzed for their level of readability using 10 quantitative readability scales. The search terms included: abdominal ultrasound, abdominal aortic aneurysm, aortic dissection, appendicitis, cholecystitis, CT abdomen, diverticulitis, ectopic pregnancy, MR angiography, ovarian torsion, pancreatitis, pelvic ultrasound, and pneumoperitoneum. Websites not written exclusively for patients were excluded from the analysis.

RESULTS

Collectively the 130 articles were written at a 12.5 grade level. Only 2 of the 130 articles were written at the NIH and AMA recommended 3rd to 7th grade. Surprisingly, 59% were written at a level that required at least a high school education (greater than 12th grade).

CONCLUSION

There is a clear discordance between the readability level of abdominal imaging diagnoses and diagnostic test performed in the emergency room with the NIH and AMA guidelines. This disconnect may negatively impact patient understanding of such Internet resources contributing to poor health outcomes and thus, should be revised for more widespread understanding by the general populace.

CLINICAL RELEVANCE/APPLICATION

Patients frequently use the Internet as an educational resource; it is therefore imperative that these resources be written no higher than the NIH and AMA recommended 7th grade level to ensure widespread understanding by the average American.

SSA06-09 Dose-Estimation of Pregnant Uterus during a Pulmonary Embolism CT-Protocol: A Simulation

Sunday, Nov. 26 12:05PM - 12:15PM Room: N226

Participants

Roy Marcus, MD, Tubingen, Germany (*Presenter*) Nothing to Disclose Roland C. Aydin, MD,MS, Garching, Germany (*Abstract Co-Author*) Nothing to Disclose Karoline S. Barth, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose Dominik Zinsser, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose Klaus Herz, Tubingen, Germany (*Abstract Co-Author*) Nothing to Disclose Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG Mike Notohamiprodjo, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess the organ dose of the uterus and fetus, in pregnant patients undergoing a pulmonary CTA using a commercial dosetracking and simulation software.

METHOD AND MATERIALS

Thirty non-pregnant female patients with suspected pulmonary embolism underwent a contrast enhanced pulmonary CTA on a 3rd generation dual source CT (SOMATOM Force, Siemens Healthcare) in single-energy mode with automatic tube voltage selection and tube current modulation. Total equivalent dose and organ dose of the uterus were automatically calculated using a commercially available dose tracking and simulation software (Radimetrics, Bayer Schering). In addition organ dose of the uterus was simulated for 1st, 2nd and 3rd trimester pregnancies; the organ dose of the fetus was simulated for the last two trimesters.

RESULTS

Median age of the patients acquired and analyzed in the retrospective study was 35 [17 - 42] years. Median CTDIVol and DLP were 3.35 [1.6 - 9.7] mGy and 107.6 [46.2 - 497.4] mGy*cm. Total equivalent dose of the clinical CT-examinations was 2.16 [1.05 - 6.50] mSv with an organ dose of 0.05 [0.013 - 0.27] mSv affecting the uterus. Simulated pregnancies showed a total equivalent dose of 2.73 [1.15 - 8.80] mSv vs. 2.73 [1.18 - 9.05] mSv vs. 2.78 [1.22 - 9.30] mSv (p < 0.0001) for 1st vs. 2nd vs. 3rd

trimester, respectively. The organ dose affecting the uterus during simulated pregnancy was 0.06 [0.016 - 0.280] mSv vs. 0.23 [0.041 - 0.890] mSv vs. 0.43 [0.11-1.82] mSv (p < 0.0001) for 1st vs. 2nd vs. 3rd trimester, respectively. The organ dose affecting the fetus during the 2nd and 3rd trimester was <math>0.15 [0.00 - 0.74] mSv and 0.22 [0.06 - 1.04] mSv, respectively (p < 0.0001)

CONCLUSION

Simulation data show the CTA to be a safe procedure during pregnancy, with a low scatter radiation to the uterus and the fetus throughout all stages of pregnancy.

CLINICAL RELEVANCE/APPLICATION

Dose simulation suggests the chest pulmonary CTA to be a safe procedure during pregnancy

t7mi;¹/₂2i;¹/₂ni;¹/₂





103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA08

Science Session with Keynote: Gastrointestinal (HCC Screening and LIRADS)

Sunday, Nov. 26 10:45AM - 12:15PM Room: E450A



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

Participants

Claude B. Sirlin, MD, San Diego, CA (*Moderator*) Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Bayer AG; Research Grant, Arterys Inc; Research Grant, Koninklijke Philips NV; Consultant, Alexion Pharmaceuticals, Inc; Consultant, AstraZeneca PLC; Consultant, BioClinica, Inc; Consultant, Bristol-Myers Squibb Company; Consultant, Bracco Group; Consultant, Celgene Corporation; Consultant, FibroGen, Inc; Consultant, Galmed Pharmaceuticals Ltd; Consultant, F. Hoffmann-La Roche Ltd; Consultant, sanofi-aventis Group; Consultant, Gilead Sciences, Inc; Consultant, ICON plc; Consultant, Intercept Pharmaceuticals, Inc; Consultant, Priser Inc; Consultant, Johnson & Johnson; Consultant, NuSirt Biopharma, Inc; Consultant, Perspectum Diagnostics Ltd; Consultant, Pfizer Inc; Consultant, Profil Institut fur Stoffwechselforschung GmbH; Consultant, Shire plc; Consultant, Tobira Therapeutics, Inc; Consultant, Takeda Pharmaceutical Company Limited; Consultant, Virtual Scopics; ;

Mustafa R. Bashir, MD, Cary, NC (*Moderator*) Research support, Siemens AG; Research support, General Electric Company; Research support, NGM Biopharmaceuticals, Inc; Research support, TaiwanJ Pharmaceuticals Co, Ltd; Research support, Madrigal Pharmaceuticals, Inc; Consultant, RadMD

Sub-Events

SSA08-01 Gastrointestinal Keynote Speaker: LIRADS Update

Sunday, Nov. 26 10:45AM - 10:55AM Room: E450A

Participants

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SSA08-02 Liver Imaging Reporting and Data System (LI-RADS) v2014: Diagnostic Value of Ancillary Features on MR Imaging

Sunday, Nov. 26 10:55AM - 11:05AM Room: E450A

Awards

Student Travel Stipend Award

Participants

Hersh Sagreiya, MD, Palo Alto, CA (*Presenter*) Nothing to Disclose Negar Iranpour, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose Amir Borhani, MD, Pittsburgh, PA (*Abstract Co-Author*) Consultant, Guerbet SA; Author, Reed Elsevier Roberto Cannella, MD, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose Alessandro Furlan, MD, Pittsburgh, PA (*Abstract Co-Author*) Book contract, Reed Elsevier; Research Grant, General Electric Company; Consultant, General Electric Company

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PURPOSE

To determine how the inclusion of ancillary features in the evaluation of liver MR imaging changes the assessment of risk for hepatocellular carcinoma (HCC) per LI-RADS v2014.

METHOD AND MATERIALS

This is an IRB-approved, HIPAA-compliant retrospective study. 32 consecutive cirrhotic patients undergoing Gd-EOB-DTPA enhanced MR imaging of the liver in a 6-month period and with at least one hepatic observation confirmed as benign or malignant were included in the study. Among these patients, a total of 49 lesions were analyzed, including 17 pathologically-proven HCCs and 34 benign lesions. Benignity was confirmed by proving long term (i.e. > 2 year) stability or disappearance at imaging follow-up. Two readers reviewed the images independently, and for each lesion they assessed LI-RADS category (LR) using i) only major criteria and ii) major and ancillary criteria. Any disagreement was resolved in consensus for statistical analysis. Concordant cases included the malignant lesions categorized as LR4 or 5 and the benign lesions categorized as LR1 or LR2. Discordant cases included the malignant lesions categorized as LR1 or 2 and the benign lesions categorized as LR4 or 5. LR3 lesions were considered

indeterminate. The chi-square test was used to determine the difference in LR3 cases between session 1 and 2. Regression analysis was performed to assess the contribution of each ancillary feature to the final LR category.

RESULTS

The inclusion of ancillary features led to a significantly higher number of concordant cases (35 vs. 20; 71% vs 41%) and lower number of indeterminate cases (10 vs. 25; 20% vs. 51%) (P=0.0052). The number of discordant cases was small and unchanged (4 vs. 4; 8%). Regression analysis, after Bonferroni correction for multiple comparisons, showed that changes in the final LR score were significantly associated with the ancillary features "hypointensity on hepatobiliary phase" (P = 0.0021) and "diameter stability >= 2 years" (P = 0.00045).

CONCLUSION

The analysis of the ancillary features included in LI-RADS v2014 results in a lower number of indeterminate cases for the assessment of risk for HCC.

CLINICAL RELEVANCE/APPLICATION

Although the analysis of LI-RADS ancillary features requires additional time, their inclusion is of key value in indeterminate cases (LR3) for determination of malignity or benignity.

SSA08-03 Imaging Outcomes of LI-RADS v2014 Category 2, 3, and 4 Observations on CT and MRI

Sunday, Nov. 26 11:05AM - 11:15AM Room: E450A

Awards

Student Travel Stipend Award

Participants

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PURPOSE

The Liver Imaging and Reporting Data System (LI-RADS) was developed to standardize the categorization and reporting of imaging observations in patients at high-risk for hepatocellular carcinoma. However, there have been relatively few studies studying the outcomes of these categories. The purpose of this study is to determine the proportion of LR-2, LR-3, and LR-4 observations that progressed, remained stable, or were downgraded at follow-up.

METHOD AND MATERIALS

This is a retrospective analysis of all clinical CT and MRI exams at our institution since 2013 reported with LI-RADS. CT was performed with 64- and 320-detector row scanners, and MRI was performed at 1.5T and 3T. Pre-contrast, late hepatic arterial, portal venous, and delayed phases were acquired. MRI included 3D fat-suppressed dynamic T1W, single-shot T2W, in- and out-of-phase, and diffusion imaging. Hepatobiliary phase was also acquired if gadoxetate disodium was used. Observation identifiers and LI-RADS categories were extracted from clinical reports. Only untreated observations that had at least one follow-up exam were included in the analysis.

RESULTS

2374 exams were reviewed. 515 category transitions in 288 observations from 171 patients (126 male, 45 female) and 515 scans (135 CT, 380 MRI) were included in the analysis. The mean age was 62 ± 10 years, and the mean follow-up interval was 158 ± 123 days (range: 8 - 779). Of 80 index LR-2 observations, 4 (5%) were downgraded to LR-1, 66 (83%) remained LR-2, and 10 (12%) progressed to LR-3 (n=5), LR-4 (n=4), or LR-M (n=1); 4 progressed to LR-4 (n=3) or LR-M (n=1) within 180 days. Of 242 index LR-3 observations, 26 (11%) were downgraded to LR-1 or LR-2, 174 (72%) remained LR-3, and 42 (17%) progressed to LR-4 (n=29), LR-5 (n=12), or LR-M (n=1); 28 (12%) progressed within 180 days. Of 193 index LR-4 observations, 36 (19%) were downgraded, 119 (62%) remained LR-4, and 38 (20%) progressed to LR-5 (n=36) or LR-M (n=2); 32 (17%) progressed within 180 days.

CONCLUSION

Only 5% of LR-2 observations progressed to LR-4 or higher within 180 days. However, LR-3 and LR-4 observations have higher potential for malignancy and should receive close attention on follow-up.

CLINICAL RELEVANCE/APPLICATION

This study provides further validation for the use of LI-RADS and its criteria. Although the maiority of observations remained stable

on follow-up imaging, the imaging outcomes of LR-2, LR-3, and LR-4 observations differ substantially.

SSA08-04 Intraindividual Comparison between CT and Gadoxetate-Enhanced MRI in the Diagnosis of Hepatic Malignancy Using the LI-RADS: Multi-Center, Multi-Reader Retrospective Study

Sunday, Nov. 26 11:15AM - 11:25AM Room: E450A

Participants

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PURPOSE

To compare the performance of computed tomography (CT) and magnetic resonance imaging (MRI) in the diagnosis of hepatic malignancy using the Liver Imaging Reporting and Data System (LI-RADS).

METHOD AND MATERIALS

Institutional review board approved this retrospective study, and the requirement for patient consent was waived. Our subjects were 234 histologically confirmed hepatic lesions (114 hepatocellular carcinomas [HCCs], 58 non-HCC malignancies, and 59 benign lesions) in 207 patients with chronic liver disease who underwent both gadoxetate-enhanced MRI and CT for suspected hepatic malignancy at 5 academic tertiary hospitals. Four abdominal radiologists first reviewed MRI data, and then CT data 4 weeks later, independently. They determined the presence or absence of the major and ancillary imaging features and performed LI-RADS categorization for each hepatic lesion. Diagnostic performance was calculated and compared using generalized estimating equations, with LR-5/5V/M considered positive for diagnosis of hepatic malignancy (HCC and other malignancies), and with LR-M considered positive for diagnosis of other malignancies.

RESULTS

In all reviewers, compared to CT, MRI showed higher sensitivity and accuracy with comparable specificity, in distinguishing hepatic malignancies from benign lesions; the pooled sensitivities, specificities, and accuracies of CT vs. MRI were 58.4% (402/688) vs. 72.4% (498/688) (P = .013), 83.5% (197/236) vs. 83.9% (198/236) (P = .257), and 64.8% (599/924) vs. 75.3% (696/924) (P = .032), respectively. However, the diagnostic performance did not differ significantly between CT and MRI in the diagnosis of non-HCC malignancies; the pooled sensitivities, specificities, and accuracies of CT vs. MRI were 50.0% (116/232) vs. 57.8% (134/232) (P = .676), 93.5% (647/692) vs. 94.5% (654/692) (P = .385), and 82.6% (763/924) vs. 85.3% (788/924) (P = .185), respectively.

CONCLUSION

Gadoxetate-enhanced MRI may be more accurate than CT in differentiating between malignant and benign hepatic lesions using the LI-RADS, but not between HCC and other malignancies.

CLINICAL RELEVANCE/APPLICATION

In the diagnosis of focal hepatic lesions using the LI-RADS algorithm in patients with chronic liver disease, more appropriate imaging modality can be used, leading to better patient management.

SSA08-05 Frequency/Prevalence of LIRADS Major and Ancillary findings on MRI in Explant Proven Hepatocellular Carcinoma

Sunday, Nov. 26 11:25AM - 11:35AM Room: E450A

Participants Evan Johnson, MD, New York, NY (*Presenter*) Nothing to Disclose Chenchan Huang, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Cristina H. Hajdu, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Krishna Prasad Shanbhogue, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the frequency/prevalence of LIRADS (v2014) major and ancillary findings on MRI in pathologically proven HCCs on explants. To assess inter-observer variability in LIRADS major and ancillary findings, and final LIRADS category.

METHOD AND MATERIALS

122 explant proven HCCs were identified in 103 patients with contrast enhanced MRI prior to explant. Two abdominal imagers reviewed each MRI and evaluated for specific LIRADS features.

RESULTS

Average lesion was 2.4 cm (0.9 to 6 cm). Lesions were rated as LIRADS 5 (reader 1, 54.1%; reader 2, 57.4%), LIRADS 4 (29.5%; 32%), and LIRADS 3 (16.4%; 10.7%). The prevalence of LIRADS major features was: arterial phase hyperenhancement (93.4%; 92.6%), portal venous phase washout (64.8%), delayed phase washout (74.6%; 73%), pseudocapsule (49.2%; 59.8%). Prevalence of LIRADS ancillary findings was: moderately increased T2 signal (88.5%), diffusion restriction (46.7%), mosaic appearance (31.1% and 27%), corona enhancement (23%; 13.9%), intralesional fat (15.6%), increased T1 signal (13.9%), nodule in a nodule appearance (8.2%; 9%), biliary dilatation (0.8%; 0.8%) and liver retraction (0.8%; 0%). Interobserver variability analysis demonstrated perfect agreement (Cohen's kappa 1.0) in presence or absence of portal venous washout, increased T2 signal, increased T1 signal, intralesional fat, diffusion signal, and biliary dilatation. Near perfect agreement was seen in arterial phase enhancement (0.88; 95% CI 0.716-1), delayed washout (0.917; 0.838-0.997), nodule in a nodule appearance (0.9; 0.763-1), and mosaic architecture (0.812; 0.701-0.924). There was substantial interobserver agreement in presence or absence of an enhancing pseudocapsule (0.612; 0.478-0.746), and moderate agreement in corona enhancement (0.502; 0.322-0.683). There was near

perfect agreement in final LI-RADS category (0.816; 0.728 to 0.904).

CONCLUSION

Arterial hyperenhancement and delayed washout were the most common LIRADS major findings in HCC. Aside from moderate T2 high signal, LIRADS ancillary findings were infrequently observed. Up to 45% of HCCs were classified as LIRADS 3/4 lesions (not meeting current OPTN criteria) with near perfect interobserver agreement.

CLINICAL RELEVANCE/APPLICATION

Majority of LIRADS features demonstrate excellent interobserver agreement with most differing opinions in presence or absence of pseudocapsule and corona enhancement.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Krishna Prasad Shanbhogue, MD - 2012 Honored EducatorKrishna Prasad Shanbhogue, MD - 2013 Honored Educator

SSA08-06 A Comparative Study of Computer-aided Diagnosis and Radiologists: LI-RADS-Based Assessment of Hepatocellular Carcinoma

Sunday, Nov. 26 11:35AM - 11:45AM Room: E450A

Participants

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PURPOSE

To quantify the major features of LI-RADS and develop a computer-aided diagnosis (CAD) system for hepatocellular carcinoma (HCC), and to evaluate the performance of our CAD system by comparing computerized assessment with radiologists' reviews.

METHOD AND MATERIALS

In this retrospective study, 65 consecutive patients in high risk of HCC were reviewed, all patients had pathologically confirmed HCC observations and underwent CT scan from January 2015 to January 2017. Two blinded radiologists assessed the major features (diameter, arterial phase hyperenhancement (APHE), washout, capsule) and assigned LI-RADS categories in consensus. For the computer-aided diagnosis(CAD), the tumors and normal liver tissue were first segmented at the maximum slice at 2-phase CT using a random-walk based interactive segmentation algorithm. Then the computer algorithm was employed to quantify the LI-RADS major features and the tumors were graded into LR3, 4, 5 based on the extracted features. Inter-reader agreement was calculated using Cohen's kappa, the accuracy of the LI-RADS categorization was compared between the radiologist and our CAD system.

RESULTS

The study included 60 males and 5 females, with a mean age of 57 ± 11.9 years) and the mean diameter of 65 observations was 45.3 ± 27.8 mm. Inter-reader agreement in major features between two radiologists was APHE (k=0.862), washout (k=0.877), capsule (k=0.785) and LR category (k=0.8). The consistency of CAD and radiologists in features detection was APHE(k=0.908), washout(k=0.908), capsule(k=0.754) and LR categorization (k=0.738). Based on the pathology, the diagnostic accuracy of CAD and radiologists was 93.8% vs 92.3%, respectively, by assuming both LR4(probably HCC) and LR5 (definite HCC) are positive. The diagnostic accuracy of CAD and radiologists was 76.9% and 64.6%, respectively, if only LR5 is positive.

CONCLUSION

Our study identified and quantified effective major features from LI-RADS and developed a computer-aided diagnosis (CAD) system for identifying HCC major features and corresponding final categorization. All three major features extracted by CAD were in good agreement with radiologists and the diagnostic accuracy of CAD in LI-RADS categorization was even higher than radiologists.

CLINICAL RELEVANCE/APPLICATION

With the involvement of computer algorithms and features quantification of LI-RADS, CAD can obtain high stability and diagnosis efficiency in HCC screening.

SSA08-07 Validation of The Liver Imaging Reporting and Data System with Gadoxetic acid-enhanced MR Imaging in a Prospective Surveillance Study: Evaluation of LI-RADS Category 4 and 5 Criteria

Sunday, Nov. 26 11:45AM - 11:55AM Room: E450A

Participants

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PURPOSE

To validate the Liver Imaging Reporting and Data System (LI-RADS) v2014 category 4 (LR-4) and 5 (LR-5) criteria on gadoxetic acid-enhanced magnetic resonance imaging (MRI) in a surveillance setting for patients with cirrhosis at high risk of hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

A prospective surveillance study recruited 407 cirrhosis patients having an estimated annual risk of HCC >5% who underwent one to three, biannual screening gadoxetic acid-enhanced MRI examinations between November 2011 and August 2014. The nodules detected on MRI were categorized according to the the LI-RADS v2014. The final diagnosis was based on the results of a histologic examination and/or follow-up image studies. The diagnostic performance of LR-5 and >=LR-4 criteria in diagnosing HCC was described and compared by per-lesion sensitivity and per-examination specificity with 95% confidence intervals (CI).

RESULTS

During the 1100 sessions of MRI, the 43 sessions detected 48 HCCs. The 13 LR-5 lesions included 12 HCCs and one inflammatory pseudotumor. The 53 LR-4 nodules were confirmed as HCC in 30, considered as presumed dysplastic nodules in five, AP shunt or small hemangioma in four, inflammatory lesions in 13 and abscess in one. The per-lesion sensitivity of LR-5 and >=LR-4 was 25 (12/48) % (95% CI, 13.6, 39.6%) and 87.5 (42/48) % (74.8, 95.3%), respectively (P<0.001). The per-examination specificity was 99.9 (1056/1057) % (99.5, 100%) and 98.5% (1041/1057) (97.6, 99.1%), respectively (P<0.001).

CONCLUSION

In cirrhotic patients at high risk of HCC, the combination of LR4 and LR-5 categories improved the per-lesion sensitivity to detect HCC with a mild compromise in the per-examination specificity.

CLINICAL RELEVANCE/APPLICATION

Our study results prospectively validate the Liver Imaging Reporting and Data System v2014 category 4 and 5 criteria on gadoxetic acid-enhanced MRI in a surveillance setting for patients with cirrhosis at high risk of HCC.

SSA08-08 CEUS LI-RADS for Interpreting Observations in Patients at Risk for HCC: A Validation Study

Sunday, Nov. 26 11:55AM - 12:05PM Room: E450A

Awards

Student Travel Stipend Award

Participants

Alina Makoyeva, MD, Calgary, AB (Presenter) Nothing to Disclose

Alexandra Medellin, MD, Calgary, AB (Abstract Co-Author) Nothing to Disclose

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Yuko Kono, MD, PhD, San Diego, CA (*Abstract Co-Author*) Equipment support, Toshiba Medical Systems Corporation; Equipment support, General Electric Company; Equipment support, Lantheus Medical Imaging, Inc

Andrej Lyshchik, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Research support, Bracco Group; Advisory Board, Bracco Group; Research support, General Electric Company; Research support, Siemens AG; Research support, Toshiba Medical Systems Corporation; Speaker, SonoScape Co, Ltd; ;

Stephanie R. Wilson, MD, Calgary, AB (*Abstract Co-Author*) Equipment support, Koninklijke Philips NV; Equipment support, Siemens AG; Equipment support, Samsung Electronics Co, Ltd; Speaker, General Electric Company; Speaker, Koninklijke Philips NV; Speaker, Saumsung

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PURPOSE

The purpose of this study is to validate the CEUS LI-RADS algorithm and determine its ability to diagnose HCC and discriminate between HCC, other malignant/pre-malignant lesions and benign liver entities. Of particular interest is the specificity of LR-5.

METHOD AND MATERIALS

229 liver lesions from a single centre assessed with CEUS were retrospectively included in a blind read (LR-5,124; LR-5V,11; LR-M,31; LR-4,12; LR-3,31; LR-2,2; LR-1,18). It comprised a single AVI file showing arrival of contrast to peak enhancement, and still grayscale, arterial and portal venous/late phase CEUS images. Three expert radiologists from two centres conducted the read using CEUS LI-RADS v2016. Readers responded on arterial, portal-venous/late phase enhancement characteristics, presence of thrombus, and timing and intensity of washout. A LI-RADS category was assigned for each case. Pathology was available for 145 cases (HCC(123), Mixed HCC/CholangioCa(1), CholangioCa(7), Metastasis(8), PEComa(1), Lymphoma(1), Benign Nodule(3)). Clinical and imaging (CT/MR) correlation was additionally used, as available.

RESULTS

Pathology proven malignancy had very strong results on CEUS. LR-5 specificity is 94%. Sensitivity and positive predictive value are 95% and 93% respectively. Youden's Index is 89%. For LR-5V and LR-M, sensitivity, specificity and positive predictive values are 100%, 100% and 87% and 79%, 97% and 88% respectively. Similar strong values are obtained for LR-1 and LR-3 (93%, 99% and 96% and 83%, 97% and 87% respectively). LR-4 category, including several different patterns suspicious for HCC, performed well with regards to specificity (98%), but less well for sensitivity and PPV (both 64%). In a blind read format, criteria for LR-4 are most challenging to interpret. LR-2 category performed least well, possibly related to its inclusion criteria of very small nodules, resulting

in a small sample entry. For inter-rater reliability, kappa value was 0.86.

CONCLUSION

CEUS LI-RADS algorithm is an excellent tool for identifying malignant and clearly benign lesions. Best performance is for HCC and non-hepatocellular malignancy.

CLINICAL RELEVANCE/APPLICATION

CEUS LI-RADS allows confident non-invasive diagnosis of HCC and other non-hepatocellular malignancies. Use of the CEUS algorithm standardizes interpretation and management of nodules in at risk patients.

SSA08-09 Using Deep Learning to Investigate the Value of 'Washin and Washout' in Hepatocellular Carcinoma for Malignancy Characterization

Sunday, Nov. 26 12:05PM - 12:15PM Room: E450A

Participants

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PURPOSE

The purpose of this study was to investigate the potential value of 'washin and washout' in HCC for malignancy characterization using deep learning.

METHOD AND MATERIALS

Forty-six consecutive patients with 46 hisotologically proven HCCs from September 2011 to October 2015 were included for this retrospective study. Gd-DTPA-enhanced MR imaging were performed with a 3.0T MR scanner, consisting of pre-contrast, arterial, portal venous, and delayed phase images. The histology grading of HCCs was retrieved from the archived clinical histology report, including twenty-one low grade and twenty-five high grade HCCs. The process of "washin" in HCC corresponds to pre-contrast and arterial images, while "washout" corresponds to arterial and portal venous images. Firstly, a resampling method was performed to extract multiple 2D orthogonal planes in 3D volumes of HCCs in each phase to increase the dataset for training. Then, deep features of HCCs in pre-contrast, arterial and portal venous phase were extracted for malignancy characterization, respectively. Finally, fusion of deep features derived from pre-contrast, arterial or portal venous phase was conducted using multi-kernel support vector machine for malignancy characterization. Values of characterization performance were denoted as mean±standard deviation as a result of 4-folded cross-validation with 10 repetitions on the data set.

RESULTS

Deep feature derived from arterial phase (0.9154 ± 0.0726) yielded best accuracy, followed by portal venous phase (0.8615 ± 0.0754) and pre-contrast (0.7769 ± 0.0639) . In terms of multimodal fusion, the accuracy of Arterial & Portal venous ("washout") (0.9198 ± 0.0754) was similar to that of the Arterial (0.9154 ± 0.0726) , while fusion of deep features in Pre-contrast & Arterial ("washin") yielded better result (0.9462 ± 0.0493) when two modalities were fused. Finally, fusion of deep features in three phases ("washin and washout") yielded best accuracy (0.9538 ± 0.0510) for malignancy characterization.

CONCLUSION

This study demonstrates that deep feature of "washin and washout" in HCCs has excellent performance for malignancy characterization.

CLINICAL RELEVANCE/APPLICATION

Deep feature is automatically learned from the images of "washin and washout" in HCCs, which may be significant to formulate gold standard for lesion characterization in clinical practice, rather than depending on radiologist interpretation or quantitation of intensity changes in the process of "washin and washout".



103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA09

Gastrointestinal (Dual/Multi Energy CT)

Sunday, Nov. 26 10:45AM - 12:15PM Room: E450B



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: <u>1.75</u>

FDA Discussions may include off-label uses.

Participants

Benjamin M. Yeh, MD, San Francisco, CA (*Moderator*) Research Grant, General Electric Company; Author with royalties, Oxford University Press; Shareholder, Nextrast, Inc; Research Grant, Koninklijike Philips NV; ; Daniele Marin, MD, Durham, NC (*Moderator*) Research support, Siemens AG Lakshmi Ananthakrishnan, MD, Dallas, TX (*Moderator*) Nothing to Disclose

Sub-Events

SSA09-01 Iodine Concentration Images in Dual-Energy CT: Improved Visualization of Washout Characteristics in Hepatocellular Carcinoma

Sunday, Nov. 26 10:45AM - 10:55AM Room: E450B

Participants

Daniela Muenzel, MD, Munich, Germany (*Presenter*) Nothing to Disclose Manuel Patino, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Anushri Parakh, MBBS, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Avinash R. Kambadakone, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Ernst J. Rummeny, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose Dushyant V. Sahani, MD, Boston, MA (*Abstract Co-Author*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc

PURPOSE

To determine the diagnostic potential of Material Density (MD) Iodine images in dual-energy CT (DECT) for visualization and quantification of the washout phenomenon in hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

The study complied with HIPAA guidelines and was approved by the ethics committee of the institutional review board. Thirty-one patients with known or suspected HCC were included. All of them underwent both single-source DECT and MRI within less than three months. Portal venous phase CT imaging was performed with dual energies of 140 and 80 kVp, and monoenergetic (Mono-E) images (at 65 keV) and MD iodine images were calculated. We determined the lesion-to-liver ratio (LLR) and the contrast-to-noise ratio (CNR) for HCC. All parameters were assessed in mono-energetic 65 keV images, MD-iodine images, and MRI. Paired t test was used to compare LLR, CNR, and ap-LLR in Mono-E, MD-iodine, and MR images.

RESULTS

The CNR was significantly higher in the MD-iodine images (0.74 ± 0.36), compared to the Mono-E (0.01 ± 0.01) and MR images (0.02 ± 0.02). Washout was represented by low LLR values, which was most obvious observed in the MD-iodine images (0.75 ± 0.13), compared to the Mono-E (0.85 ± 0.12) and MR images (0.87 ± 0.12).

CONCLUSION

MD-iodine images in DECT improve the visualization of the washout phenomenon in HCC and allows for quantitative measurements.

CLINICAL RELEVANCE/APPLICATION

Washout phenomenon is a diagnostic imaging marker of HCC, which is significantly better visible in MD iodine images. In addition, quantitative iodine assessment of washout makes examinations comparable, even if patients were not examined at the identical scanner installation each time.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Dushyant V. Sahani, MD - 2012 Honored EducatorDushyant V. Sahani, MD - 2015 Honored EducatorDushyant V. Sahani, MD - 2016 Honored EducatorDushyant V. Sahani, MD - 2017 Honored Educator

SSA09-02 Value of Single Source Dual Energy CT Based Unenhanced Cystic Component in Differential Diagnosis of Liver Abscess and Liver Metastases

Sunday, Nov. 26 10:55AM - 11:05AM Room: E450B

Participants

Nan Wang, Dalian, China (*Presenter*) Nothing to Disclose Ailian Liu, MD, Dalian, China (*Abstract Co-Author*) Nothing to Disclose Jianying Li, Beijing, China (*Abstract Co-Author*) Employee, General Electric Company Anliang Chen, Dalian, China (*Abstract Co-Author*) Nothing to Disclose Xiaodong Liu, Dalian, China (*Abstract Co-Author*) Nothing to Disclose Fengming Tao, Dalian, China (*Abstract Co-Author*) Nothing to Disclose Ying Zhao JR, Dalian, China (*Abstract Co-Author*) Nothing to Disclose Mingzhe Xu, Dalian, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate value of ssDECT based unenhanced cystic component in differential diagnosis of liver abscess and liver metastases.

METHOD AND MATERIALS

From September 2011 to Dec 2016, 58 patients with 79 liver lesions(29 liver abscess by percutaneous drainage or combining with clinical symptom and imaging after follow-up, and 50 liver metastases by imaging, medical history and follow-up) underwent ssDECT with GSI. All lesions have obvious liquefaction necrosis area. The mean CT of value of monochromatic (40-140)keV, fat (water) and blood (water) concentration for the lesions and effective atomic number(eff-Z) were measured by a senior medical doctor and an observer on an AW 4.5 workstation. The two measurement data have good consistency(ICC>0.75). the data of the senior medical doctor was selected to use Mann-Whitney rank sum test. The slope of spectral curve(K) was measured and divide into 3 types: decrement curve(K<-0.1), straight curve(-0.1<=K<=0.1) and increment curve(K>0.1). ROC curves were then constructed to evaluate the effectiveness of each parameter.

RESULTS

The range of single-energy CT values of liver metastases [from (20.09 ± 7.48) HU to (31.04 ± 15.29) HU] was significantly higher than that of liver abscesses [from (17.79 ± 8.17) HU to (20.54 ± 13.28) HU] at energy levels ranging from 40 to 110 keV(P<0.05). When CT value at 40 keV greater than 30.49 HU, the specificity and sensitivity of liver metastases except liver abscess were 82.8% and 56% (AUC=0.701). The median blood-water concentration of liver metastases was 523.85mg/cm3, significantly higher than that of liver abscesses (352.86mg/cm3, P<0.05). The median fat-water concentration of liver abscesses was -84.89mg/cm3, significantly higher than that of liver metastases (-124.64mg/cm3,P<0.05). The eff-Z of liver metastases(7.66\pm0.16)was significantly higher than that of liver abscesses (7.58\pm0.14, P<0.05). In the 29 liver abscesses, there are 14(48.3%) straight curves , while in the 50 liver metastases, there were 27(54%) descending curves.

CONCLUSION

Spectral CT-based unenhanced cystic component is an effective methods in differential diagnosis of liver abscess and liver metastases.

CLINICAL RELEVANCE/APPLICATION

ssDECT provide more information for clinical diagnosis by plain scan.

SSA09-03 Enhanced Demarcation of Hepatic Metastases from Colorectal Cancer Using Noise-Optimized Virtual Monoenergetic Reconstructions from Dual-energy Computed Tomography of the Liver

Sunday, Nov. 26 11:05AM - 11:15AM Room: E450B

Participants

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PURPOSE

The aim of this study was to evaluate the impact of noise-optimized virtual monoenergetic imaging (VMI+) reconstructions on quantitative and qualitative image parameters in patients with hepatic metastases from colorectal cancer at abdominal dual-energy computed tomography (DECT).

METHOD AND MATERIALS

Forty-two patients (29 men; 67.1 ± 12.3 years) with histopathologically confirmed hepatic metastases from colorectal cancer underwent triphasic contrast-enhanced DECT of the abdomen. Images from the portal venous phase were post-processed with the standard linear blending technique (M_0.6) as well as with the traditional virtual monoenergetic (VMI) and noise-optimized VMI+ algorithms in 10-keV intervals from 40 to 100 keV. Attenuation measurements were performed in hepatic lesions, unaffected liver tissue, rectus abdominis muscle, and adjacent visceral fat to calculate objective signal-to-noise (SNR) and contrast-to-noise (CNR) ratios. Five-point scales were used to evaluate overall image quality and lesion delineation by three blinded radiologists with varying levels of experience.

RESULTS

Objective indices SNR and CNR (negative values indicating best contrast of hypoattenuating lesions) of liver metastases were best in 50-keV VMI+ series (3.5 ± 2.1 and -3.6 ± 2.0), significantly superior to all other reconstructions (all *P*<0.001; SNR M_0.6: 2.4 ± 1.5 ; CNR M_0.6: -2.6 ± 1.8). Qualitative image parameters showed highest values for 50-keV VMI+ reconstructions (median 5, respectively; *P*<=0.023) regarding overall image quality. Qualitative assessment of lesion delineation peaked in 40-keV VMI+ (median 5) and 50-keV VMI+ (median 4; *P*=0.067), significantly superior to all other reconstructions (all *P*<0.001; M_0.6: median 3).

CONCLUSION

Noise-optimized VMI+ reconstructions at 50 keV can substantially increase quantitative image quality and improve subjective assessment of overall image quality and lesion delineation of hepatic metastases from colorectal cancer compared to standard image reconstruction and traditional VMI.

CLINICAL RELEVANCE/APPLICATION

Detection of hepatic metastases from colorectal cancer could be improved using noise-optimized VMI+ post-processing in patients undergoing contrast-enhanced DECT of the liver.

SSA09-04 Dual-Energy Spectral CT: Improving Preoperative Diagnostic Accuracy of Regional Lymph Node Metastasis in Colorectal Cancer

Sunday, Nov. 26 11:15AM - 11:25AM Room: E450B

Participants

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PURPOSE

To investigate the performance of Dual-Energy Spectral CT (DEsCT) in preoperative diagnosis of regional metastatic lymph nodes(LNs) in patients with colorectal cancer (CRC).

CONCLUSION

The preoperative diagnostic accuracy of lymph node metastasis in patients with CRC can be significantly improved by using quantitative parameters derived from DEsCT.

CLINICAL RELEVANCE/APPLICATION

The quantitative parameters derived from DEsCT can be used to improve preoperative identification of lymph node metastasis in patients with CRC.

SSA09-05 Iodine Quantification on Spectral Detector-based Dual-energy CT Enterography: Correlation with Crohn's Disease Activity Index

Sunday, Nov. 26 11:25AM - 11:35AM Room: E450B

Participants

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PURPOSE

To correlate CT parameters including iodine concentration on spectral detector-based dual-energy CT enterography (DE CTE) with Crohn's disease activity index (CDAI).

METHOD AND MATERIALS

From June 2016 to May 2017, 39 patients with known CD were retrospectively enrolled. Two radiologists reviewed spectral detector-based DE CTE images in consensus for the location and number of involved bowel, wall thickness, enhancement pattern, subjective degree of enhancement, degree of mesenteric fat infiltration, comb sign, lymphadenopathy, fistula, and obstruction, and the presence of mesenteric abscess or gallstone. For the quantitative analysis, HU and iodine concentration (mg•I/ml) for the diseased bowel with the strongest enhancement were measured on conventional polychromatic image and iodine quantification map, respectively. Pearson's correlation test and multiple linear regression analysis assessed the correlation between CT parameters and CDAI.

RESULTS

Significant correlations were found between CDAI and several CT parameters such as number of lesions (correlation coefficient=0.573), bowel wall thickness (0.477), pattern of bowel wall enhancement (0.428), subjective degree of enhancement (0.656), mesenteric fat infiltration (0.567), comb sign (0.664), and fistula (0.425) (P<0.05). In addition, there were significant correlations between CDAI and other quantitative CT parameters such as iodine concentration (correlation coefficient=0.744) and relative degree of enhancement (correlation coefficient=0.541) (P<0.001). However, only iodine concentration measured on iodine map remained an independent variable associated with CDAI after adjustment for other confounders in multivariate analysis

(P=0.001). The linear regression equation for CDAI (Y) and iodine concentration (X) was Y = 53.549X + 55.111 with R2=0.726.

CONCLUSION

Iodine concentration measured on spectral detector-based DE CTE represents an easy and convenient biomarker to monitor the disease activity of CD.

CLINICAL RELEVANCE/APPLICATION

Crohn's disease activity can be quantified and monitored by iodine concentration measured on the diseased bowel using spectral detector-based dual-energy CT enterography.

SSA09-06 Feasibility of Using Monochromatic Imaging and Adaptive Statistical Iterative Reconstruction (ASIR) Combined With GSI Assist for Individually Reducing Radiation and Iodine Contrast Dose in Computed Tomographic Enterography

Sunday, Nov. 26 11:35AM - 11:45AM Room: E450B

Participants

Hongran Liu, MD, Wuhan, China (*Presenter*) Nothing to Disclose Xin Li, MD, PhD, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose Ming Yang, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose Ping Han, MD, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose CEN CHEN, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose Yu Zhang, MS, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the image quality and feasibility of using monochromatic imaging and ASIR combined with GSI Assist for individually reducing radiation and iodine contrast dose in CT enterography.

METHOD AND MATERIALS

101 patients (68M, 33F, age 18-78 years ,BMI 18.59-28.73) with proven or suspected small intestinal disease were randomly divided into four groups: group A (n=27) and group B (n=20) were scanned with 120 kVp polychromatic imaging using noise index (NI) of 10 with FBP reconstruction; group C (n=25) and group D (n=29) were scanned by using GSI Assist using NI of 10 (group C) and 13 (group D). And contrast medium protocol were 450mgI/kg for group A, and 300mgI/kg for group B, C, D. Regions of interests were drawn in distance ileum wall and nearby intestinal lumen, optimal keV were generated by GSI viewer automaticly. GSI groups were reconstructed at optimal keV with 50%ASIR. Quantitative parameters (CT values, standard deviation (SD) of portal vein, paraspinal muscle and fat, SNR, CNR) were measured and image quality were qualitatively assessed.

RESULTS

The range of the optimal keV of the group C and D were 57-64keV. The CT values in group A, C and D was found no significant difference, but higher than that in group B; Image noise in group A and B showed no significant difference, but was higher than that in group D; Image noise in group C was the least; The SNR and CNR in group D were lower than that in group C but higher than group A and B; The subjective image assessment in group A and D provided similar image quality, but lower than that in group C. There were no significant differences among the group A, B and C in CTDIvol and DLP, but dose in group D was significantly lowest. The CTDIvol and DLP were reduced by 34.01% and 34.28% respectively compared with 120kV scans.

CONCLUSION

The use of monochromatic imaging at 60kev and 50%ASIR combined with GSI Assist can individually reduce radiation and iodine dose without decreasing image quality in CT enterography.

CLINICAL RELEVANCE/APPLICATION

It will be great beneficial for patients who often undergo numerous imaging reexaminations to take individualized therapeutic options and monitor the response to therapy. Various parameters of the spectral CT may be helpful in the detection of bleeding, reduction of beam-hardening artifact, inflammation and tumor discrimination, staging or grading and other aspects of the clinical application as the GSI imaging dose reduced.

SSA09-07 In Vivo CT Imaging Performance of a Tantalum-Based Nanoparticle Contrast Agent Compared to Iopromide at Large to Obese Patient Sizes Simulated by Swine in Adipose-Attenuation Plastic Encasements

Sunday, Nov. 26 11:45AM - 11:55AM Room: E450B

Participants

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PURPOSE

To compare the CT imaging performance of a carboxybetaine zwitterionic-coated tantalum oxide (TaCZ) nanoparticle contrast agent against a conventional iodinated agent (iopromide) for vascular and visceral enhancement in large to obese patient sizes simulated by swine in adipose-attenuation plastic encasements.

METHOD AND MATERIALS

In our institutional animal care and use committee-approved study, we imaged 30- to 68-kg swine placed inside three adiposeattenuation plastic rings sized to simulate large, obese, and morbidly obese abdominal girths of 102 cm, 119 cm and 137 cm. Swine were then injected with either IV TaCZ or iopromide at 500 mg element/kg, given over 30 seconds and imaged with scan delays of 29, 39, 60, and 80 seconds on a clinical 64-detector-row CT scanner. Each swine was scanned in a given adipose ring size with each agent in consecutive weeks; two different swine were used for each of the six agent/girth combinations. Two blinded readers independently scored scans for the clarity of specific visceral arteries and veins on a five-point Likert scale using 0 = "not seen" to 4 = "vivid clarity" (individual visceral arteries at all phases, individual visceral veins at 60- and 80-second scan delays). The objective intensity of contrast enhancement was measured by 5 regions of interest placed in the aorta and liver. Findings were compared by paired t-tests and Wilcoxon signed rank tests.

RESULTS

The mean peak enhancement was significantly higher for TaCZ than for iopromide for the aorta (270 versus 199 HU, respectively, p<0.001) and in the liver (61.3 versus 45.2 HU, respectively, p<0.001). The TaCZ vascular clarity score was higher than iopromide in 59%, 82% and 85% of the individual vessels at the 102 cm, 119 cm and 137 cm sizes respectively (p<0.01). TaCZ was scored higher than iopromide in 62% of the arteries and in 89% of the veins (p<0.01). None of the vessels showed lower clarity scores with TaCZ than with Iopromide.

CONCLUSION

Tantalum-based contrast material provides higher contrast enhancement compared to equal-dose iopromide in large to obese simulated patient sizes.

CLINICAL RELEVANCE/APPLICATION

Swine/phantom results suggest that tantalum-based contrast material may dramatically improve vascular and visceral contrast enhancement and improve diagnostic utility at CT in large to obese patients.

SSA09-08 Machine Learning Of Dual Energy CT Data from Liver Tumors: Impact on Predictive Value for Ablation Success

Sunday, Nov. 26 11:55AM - 12:05PM Room: E450B

Participants

Gert Van Gompel, PhD, Brussel, Belgium (*Presenter*) Nothing to Disclose David Frimpong, Brussels, Belgium (*Abstract Co-Author*) Nothing to Disclose Frederik Vandenbroucke, MD, Brussels, Belgium (*Abstract Co-Author*) Nothing to Disclose Koenraad H. Nieboer, MD, Brussels, Belgium (*Abstract Co-Author*) Speaker, General Electric Company Johan De Mey, Jette, Belgium (*Abstract Co-Author*) Nothing to Disclose Nico Buls, DSc, PhD, Jette, Belgium (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To investigate the potential of machine learning based on texture analysis of dual energy CT (DECT) images for the prediction of local tumor progression (LTP) after RF ablation of focal liver lesions, and to compare its added value with a similar approach based on standard CT images.

METHOD AND MATERIALS

This study comprises a retrospective analysis for 39 patients who received a DECT scan (Discovery HD, GE Healthcare) of the liver, acquired within 24 hours after RF ablation of a liver lesion. For each DECT data set, a mask was generated based on the segmented ablation zone. For each of the obtained monochromatic image series (40keV-140keV) of the DECT scan, texture analysis was performed within the mask by building a GLCO matrix and extracting 12 relevant tissue texture features (of which contrast, energy and entropy). Absence or presence of LTP was registered from follow-up imaging during at least 1 year after ablation. A support vector machine (SVM) algorithm was used to predict LTP from the features for all monochromatic series. Results were compared to the SVM prediction based on the texture statistics of 70keV image series only, which are representative for standard CT image.

RESULTS

The SVM algorithm was trained based on data from 32 patients. The ROC analysis of prediction of LTP of the training set showed a higher area under curve (AUC) when based on the DECT series compared to the standard CT series (0.81 vs. 0.49). For DECT, at optimal cutoff, sensitivity and specificity were respectively 51% and 95%, whereas for the standard CT a sensitivity of 20% and specificity of 86% was observed.

CONCLUSION

Our results suggest that an SVM algorithm applied on texture statistics of DECT data might be more sensitive to residual tumor, yielding a more accurate predictor for LTP, compared to a similar approach based on standard CT data. Additional experiments on testing data and optimization of the used images and texture features are needed to confirm these preliminary findings.

CLINICAL RELEVANCE/APPLICATION

Early finding of residual tumor tissue after RF ablation can help to improve long-term patient outcome.

SSA09-09 Dual-Energy CT for Liver Iron Quantification in Patients with Hematological Disorders

Participants

Sebastian Werner, Tuebingen, Germany (Presenter) Nothing to Disclose

Marius Horger, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To assess the feasibility of virtual iron content (VIC) imaging at dual-energy computed tomography (DECT) for evaluation of the liver iron content (LIC) in patients with hematological disorders using a new examinational technique.

METHOD AND MATERIALS

The local institutional review board gave its approval for the retrospective evaluation of non-contrast CT-image data obtained in hematological patients in the routine diagnosis for exclusion of pulmonary infection during antitumor treatment. All patients received chest-CT which included the upper half of the liver and spleen. Examinational protocol was dual energy (DE, 100 and 140kV), 89 mAs, 0.28 rotation time, pitch 0.7, 64x0.6 acquisition, 1.5mm slice thickness, 1 mm increment, medium smooth Q30f kernel and iterative reconstruction (i3). Image data was post-processed with an automatic algorithm on a prototype. After material decomposition, a liver map was created and a freehand ROI was drawn including most of the examined liver. The mean CT value (HU) was calculated and subsequently the virtual iron content (VIC) expressed in mg/ml. All patients had current serum ferritin values as part of the work-up of their underlying disease. Image data of 70 patients examined between September 2016 and March 2017 could retrospectively be analyzed. Mean time interval between CT and serum ferritin quantification was 1 day (SD, 10d). Patients with normal serum ferritin values who did not receive blood products were considered controls.

RESULTS

32 (27.1%) patients (controls) had no blood transfusions whereas 72.9% had one or more transfusions. Mean serum ferritin value and VIC was 240.7 μ g/dl (range, 1.3-2628.0 μ g/dl) and 1.34 mg/ml (range, -0.83-7.56 mg/ml) in the post-transfusional group and 74.2 μ g/dl (range, 3.0-456.0 μ g/dl) and 0.7 mg/ml (range, -2.1-3.0) in the control group. Correlation between measured mean iron value and serum ferritin was strong (ρ = 0.62) (p<0.0001).

CONCLUSION

Calculated hepatic VIC using the new examinational protocol and post-processing prototype strongly correlates with serum ferritin values and could be used in the routine diagnosis for evaluation of post-transfusional hemosiderosis.

CLINICAL RELEVANCE/APPLICATION

Elevated LIC can be damaging in particular in patients exposed to other hepatotoxic drugs (e.g. chemotherapy) and therefore accurate and simple quantification is desirable.







SSA10

Genitourinary (Functional Renal Imaging and Contrast Issues)

Sunday, Nov. 26 10:45AM - 12:15PM Room: E351



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

Participants

Harriet C. Thoeny, MD, Bern, Switzerland (*Moderator*) Advisory Board, Guerbet SA Zhen J. Wang, MD, Hillsborough, CA (*Moderator*) Stockholder, Nextrast, Inc

Sub-Events

SSA10-01 Intravenous Administration of Iodixanol is Not Associated with Increased Risk of Acute Kidney Injury, Dialysis, or Mortality: A Propensity Score-Adjusted Study

Sunday, Nov. 26 10:45AM - 10:55AM Room: E351

Participants

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David F. Kallmes, MD, Rochester, MN (*Abstract Co-Author*) Research support, Terumo Corporation Research support, Medtronic plc Research support, Sequent Medical, Inc Research support, Benvenue Medical, Inc Research support, General Electric Company Consultant, General Electric Company Consultant, Medtronic plcConsultant, Johnson & Johnson

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PURPOSE

To compare the rates of acute kidney injury (AKI), emergent dialysis, and short-term mortality between patients who were intravenously administered the iso-osmolar contrast material (IOCM) iodixanol and patients who underwent a noncontrast Computed Tomography (NCCT) scan.

METHOD AND MATERIALS

Study design and implementation for our study were overseen by our institutional review board and conformed to HIPAA guidelines on patient data integrity. All patients who received an iodixanol-enhanced (IOCM group) or noncontrast (NCCT group) CT scan from January 2003 to December 2014 were identified. Patients were subdivided into CKD Stage I-II (eGFR > 60 ml/min/1.73m2), III (eGFR 30-59 ml/min/1.73m2), and IV-V (eGFR<30 ml/min/1.73m2) subgroups and separately underwent propensity score stratification and matching. Rates of AKI, emergent dialysis, and mortality were compared between IOCM and NCCT groups. Additional analyses incorporating IV fluid administration, including additional CT scans from other sites within our instutition, and a paired analysis of patients that received both IOCM and NCCT scans during the study timeframe were also performed.

RESULTS

A total of 5758 patients (1538 CKD Stage I-II; 2899 CKD Stage III; 1321 CKD Stage IV-V) were included in the study. Following propensity score adjustment, rates of AKI, dialysis, and mortality were not significantly higher in the IOCM group compared to the NCCT group for all CKD subgroups (AKI ORs 0.74-0.91, p=.16-.69; dialysis ORs 0.74-2.00, p=.42-.76, mortality ORs = 0.98-1.24, p=.39-.88). Sensitivity analyses yielded similar results.

CONCLUSION

Among patients at highest perceived risk of PC-AKI, intravenous administration of iodixanol for contrast-enhanced CT was not an independent risk factor for AKI, dialysis, or mortality.

CLINICAL RELEVANCE/APPLICATION

Among patients at highest perceived risk of PC-AKI, intravenous administration of iodixanol for contrast-enhanced CT was not an independent risk factor for AKI, dialysis, or mortality.

SSA10-02 Role of Renal Doppler and Shear Wave Elastography in Diabetic Nephropathy

Sunday, Nov. 26 10:55AM - 11:05AM Room: E351

Awards

Student Travel Stipend Award

Participants Venkatram Krishnan, MBBS , New Delhi, India (*Presenter*) Nothing to Disclose Amita Malik, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Currently albuminuria is used for diagnosis of diabetic nephropathy; this has poor sensitivity and specificity, especially in its early stages. A combination of intrarenal resistive index and renal shear modulus, which indirectly measures intrarenal fibrosis, may enable its early diagnosis, as this study attempts to evaluate. There have been virtually no studies on combination of the two in diabetic nephropathy.

METHOD AND MATERIALS

This cross-sectional study consisted of 260 consecutive consenting subjects - 130 cases of diabetic nephropathy (diagnosis confirmed by albuminuria >30 mg/24 hrs with highly sensitive Hemo-One analyzer) and 130 healthy non-diabetic controls, who underwent grey scale ultrasound, renal acoustic radiation force impulse elastography for average shear modulus, and renal doppler for average intrarenal resistive index, of both kidneys. The eGFR for each of the subjects was calculated from the serum creatinine value using modified MDRD formula.

RESULTS

The mean intrarenal resistive index of the cases was found to be higher than that of the controls (0.72 vs 0.62, p<0.001). A progressive rise in resistive index was found with each stage of diabetic nephropathy, highest in stage V (mean 0.78). The mean shear modulus of cases, overall and in each stage, was also found to be higher than that of the controls (8.59 vs 4.32 kPa, p<0.001). A significant rise in shear modulus was noted in the initial stages, highest in stage II (mean 10.76 kPa). In later stages, a progressive decrease in shear modulus was observed. Maximum accuracy for diagnostic performance of resistive index was at a cut off of 0.65 (sensitivity and specificity of 90% and 76.2% respectively), while that for shear modulus was at 5.31 kPa (90.8% and 84.6%). Combined use of both in parallel gave the highest accuracy (81.7% and 96.3%). Very good interrater agreement was present between resistive index and shear modulus (κ 0.85).

CONCLUSION

A combination of renal doppler and renal shear wave elastography provides an excellent, simple, accurate and noninvasive tool for the early diagnosis as well as assessment of stage of diabetic nephropathy.

CLINICAL RELEVANCE/APPLICATION

Early diagnosis of diabetic nephropathy and adoption of multifactorial interventions with renoprotective agents for its treatment can halt or slow its progression.

SSA10-03 Functional MRI for Quantification of Renal Perfusion Changes After Pharmacological Intervention with an Angiotensin Converting Enzyme Inhibitor

Sunday, Nov. 26 11:05AM - 11:15AM Room: E351

Participants

Tobias Getzin, MD, Hannover, Germany (*Presenter*) Nothing to Disclose May Marcus, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose Frank K. Wacker, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose Martina Schmidbauer, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose Christoph Schindler, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose Katja Hueper, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Evaluating the applicability of arterial spin labeling (ASL) and T1 mapping to quantify the effect of pharmacological intervention with the angiotensin converting enzyme (ACE) inhibitor Captopril on kidney perfusion and T1 relaxivity of renal tissue.

METHOD AND MATERIALS

15 healthy adults (22-50 years) were examined with a 1.5T MRI (Siemens Avanto), twice at baseline conditions and 60 minutes after a single oral dose of 50 mg Captopril. The MRI protocol consisted of flow-alternating-inversion-recovery (FAIR) true-FISP ASL, a modified look-locker inversion recovery (MOLLI) sequence and standard morphological sequences (12 minute scan time). Mean renal perfusion and T1-relaxation times were calculated for the renal cortex. Inter-study and inter-reader reproducibility of MRI parameters were tested in addition to the pharmacological effect of Captopril on MRI parameters.

RESULTS

Inter-study reproducibility of ASL-based perfusion analysis was excellent with an intraclass correlation coefficient (ICC) of 0.77. Mean perfusion and T1-values did not differ between the two examinations under baseline conditions (369 ± 48 vs. 369 ± 39 ml/min/100g; 1116 ± 71 vs. 1100 ± 45 ms). Inter-rater agreement of perfusion analysis was also excellent, with an ICC of 0.97. After application of Captopril, the mean cortical kidney perfusion increased significantly by 22% (369 ± 48 vs. 452 ± 56 ml/min/100g, p<0.001), while cortical T1 times remained stable (1116 vs. 1161 ms). Statistical power analysis showed that only a small sample size is necessary to capture a significant change in kidney perfusion after pharmacological intervention with a high statistical power (8 volunteers for a statistical power of 95%).

CONCLUSION

ASL and T1 mapping provide functional MRI parameters with high inter-study and inter-rater reproducibility and are useful to measure the effect of pharmacological intervention with a low number of study participants.

CLINICAL RELEVANCE/APPLICATION

We show that ASL can rapidly quantify pharmacologically induced changes in kidney perfusion and believe that fMRI can be a beneficial tool to study effects on the kidney in drug development trials.

SSA10-04 Assessment of Renal Fibrosis with T1-mapping: An Experimental Study in a Rat of Unilateral Ureteral

Obstruction

Sunday, Nov. 26 11:15AM - 11:25AM Room: E351

Participants Genwen Hu, MD, Shenzhen, China (*Presenter*) Nothing to Disclose Xianyue Quan, MD, PhD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Jianming Xu, Shenzhen, China (*Abstract Co-Author*) Nothing to Disclose Liangping Luo, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Yingjie Mei, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To investigate the potential of magnetic resonance imaging (MRI) T1-mapping, using a look-locker inversion recovery sequence from 3.0T clinical MR scanner, in assessment of renal fibrosis using a rat model of unilateral ureteral obstruction (UUO).

METHOD AND MATERIALS

This study was approved by the institutional animal care and use committee. UUO was created in each of 36 rats. UUO-A group with 6 rats, longitudinal T1-mapping was performed before the UUO (day 0) and on days 1, 3, 5, 10, and 15 after the UUO and was followed by histopathologic analysis (one rat died on 11 days after the UUO). Six rats from UUO-B group (n = 30) were examined at each of five time points on days 0, 1, 3, 5 and 10 after the UUO. Four rats from Sham group (n = 12) were examined on days 1, 5, and 15 after UUO. Hematoxylin-eosin, Masson trichrome staining and a-smooth muscle actin (a-SMA) were performed. T1 relaxation times of renal parenchyma were analyzed and correlated with a-SMA expression level.

RESULTS

Histopathologic examination revealed typical renal fibrosis on the side with UUO. The T1 relaxation times increased over time on the UUO side, Mean T1 relaxation times with day 0, 1, 3, 5, 10, and 15 after the UUO were 1168.41 \pm 76.73, 1269.94 \pm 91.47, 1516.37 \pm 103.59, 1550.41 \pm 115.96, 1696.57 \pm 85.60, 1852.46 \pm 137.39 ms, respectively. Sham rats were 1215.13 \pm 80.77, 1194.47 \pm 51.51, 1232.28 \pm 57.48 ms, respectively. Mean T1 relaxation times associated positively (r =0.854 P < 0.001) with a-SMA expression level.

CONCLUSION

In this model, renal fibrosis was detected with T1 mapping; the degree of fibrosis was correlated with degree of increase in T1 relaxation times measurements.

CLINICAL RELEVANCE/APPLICATION

T1-mapping shows great potential in noninvasive assessment of renal fibrosis induced by UUO. T1-mapping may provide a useful tool in Assessment of renal fibrosis.

SSA10-05 Glomerular Filtration Rate: CT Measurement from Fractional Renal Accumulation of Iodinated Contrast Material

Sunday, Nov. 26 11:25AM - 11:35AM Room: E351

Participants

Shan You, Beijing, China (*Presenter*) Nothing to Disclose Xiaodong Yuan, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Wenwei Shi, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Tingting Ma, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Ning Wu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Guokun Ao, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Jing Zhang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To present a convenient, rapid CT measurement of split glomerular filtration rate (GFR) by using nephrographic phase CT acquisition, and compare it with renal dynamic imaging Gates method.

METHOD AND MATERIALS

This prospective study was approved by our institutional review board. Twenty patients with renal tumors referred for multiphasic CT and the 99mTc-DTPA renal dynamic imaging for preoperative evaluation were prospectively included. The multiphasic CT consisted of non-contrast, arterial, venous, and nephrographic phase acquisition. The latter was performed at 120 seconds after the arterial phase acquisition. The amount of the iodinated CM accumulated in the kidney (CMkidney) at the nephrographic phase was calculated as Volumekidney × (HUnephrographic - HUprecontrast) / F, in which the F is the conversion factor between the iodine concentration and the CT number enhancement. The total amount of the CM administration (CMtotal) was known and could be calculated as the product of the volume of the CM injection and the iodine concentration (370mgI/ml). The fractional renal accumulation (FRA) of the iodinated CM was calculated as the ratio of the CMkidney to the CMtotal (FRA= CMkidney / CMtotal). The FRA was then correlated with 99mTc-DTPA dynamic imaging single-kidney Gates-GFR. From this correlation a formula was derived for single-kidney CT-GFR calculation, which in turn was compared with single-kidney Gates-GFR by using correlation analysis and Bland-Altman plots, with employing a leave-one-out procedure to ensure robustness of our findings.

RESULTS

The FRA (x) in mean \pm SD was 2.97% \pm 1.04%, correlated well (r=0.90, p<0.001) with single-kidney Gates-GFR (y), producing regression equation: y=1452.6*x+1.36 for single-kidney CT-GFR calculation. Single-kidney CT-GFR (44.33 \pm 15.27ml/min) correlated

well (r=0.89, p<0.001) with single-kidney Gates-GFR (44.47 ± 16.79 ml/min). Bland-Altman plots demonstrated that the 95%CI of measurement deviation of the FRA between the two methods is ±14.82 ml/min without systemic bias (p=0.902).

CONCLUSION

A convenient, rapid CT measurement of split renal function was presented, which correlates and agrees well with the reference standard, therefore could be used as a one-stop-shop technique for preoperative evaluation of renal morphology and split function of renal tumors, without additional radiation dose.

CLINICAL RELEVANCE/APPLICATION

A convenient, rapid CT GFR measurement without additional radiation dose

SSA10-06 Renal Size Measurements on Pre- TAVR CT Angiogram as a Predictor of Post Procedure Acute Kidney Injury

Sunday, Nov. 26 11:35AM - 11:45AM Room: E351

Participants

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PURPOSE

We aimed to correlate renal size measurements such as renal length, renal parenchymal area and renal cortical area on pre-TAVR CT angiogram with post procedure acute kidney injury (AKI)

METHOD AND MATERIALS

This is a single-center retrospective cohort study of 101 TAVR patients (10/2013 to 5/2016). Post-TAVR AKI was defined by Kidney Disease: Improving Global Outcomes (KDIGO) SCr-based criteria. Demographic and clinical data were extracted from medical records. Pre-TAVR CT angiograms were analyzed using an Aquarius 3D Workstation (TeraRecon, San Mateo, CA).Various measurements including renal length, renal parenchymal area and renal cortical area were evaluated by 2 independent, blinded readers from a midline sagittal image reconstructed from axial and coronal images. Univariate comparisons between patients who did and did not develop AKI were made for radiologic measurements using t-test and Chi-square test as appropriate. Multivariable logistic regression was used to assess association of renal length, renal parenchymal area and cortical area with post-TAVR AKI with adjustment for pre-procedural renal function and other clinical predictors that were significant for association in univariate analysis (p<0.05).

RESULTS

Acute kidney injury, occurred in 20 of 101 patients after TAVR. Univariate assessments of characteristics of subjects who did and did not develop post-TAVR AKI are shown in Table1. Combined renal length of both kidneys (p-value 0.023, OR= 0.715, 95% CI 0.535.0.956), combined bilateral renal parenchymal area (p-value 0.025, OR= 0.955, 95% CI 0.918, 0.994) and combined bilateral renal cortical area (p-value 0.021 OR= 0.935, 95% CI 0.880, 0.993) were smaller in patients who developed post-TAVR AKI.

CONCLUSION

Predictors of post TAVR acute kidney injury include combined renal length, renal parenchymal area and renal cortical area.

CLINICAL RELEVANCE/APPLICATION

It is important to identify imaging characteristics that are associated with increased risk of AKI and other adverse post-procedural outcomes after TAVR so that better targeted preventions and interventions can be designed to mitigate these outcomes in the peri-procedural setting

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Suhny Abbara, MD - 2014 Honored EducatorSuhny Abbara, MD - 2017 Honored Educator

SSA10-07 Dual Contrast K-Edge Renal Perfusion Imaging Using Spectral Photon-Counting CT

Sunday, Nov. 26 11:45AM - 11:55AM Room: E351

Participants

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METHOD AND MATERIALS

Dynamic renal perfusion imaging was performed in 2 rabbits using SPCCT with multiple energy bins (Philips Healthcare, Haifa, Israel), with a voxel size of 0.25*0.25*0.25 mm, every 1.5 seconds over a period of 45 seconds starting after a simultaneous intravenous administration of 9 ml of gadolinium (78.5mg of Gd /ml, 3 ml/kg, Dotarem, Guerbet), and 3 ml of iodine (400 mg of I /ml, 1 ml/kg, Iomeron, Bracco). Acquisition was performed under 2 conditions: baseline and dopamine infusion. SPCCT provided conventional CT, material decomposition water/iodine and gadolinium specific K-edge images. Aortic and cortical time-attenuation curves were modeled to measure time to peak (TTP) and mean transit time (MTT) using a validated gamma variate model. Measurements of Gd K-edge and iodine perfusion were compared using Pearson correlation analysis with the reference method using conventional CT images.

RESULTS

SPCCT provided high resolution conventional HU, specific gadolinium K-edge and iodine material decomposition images of the cortex and the medulla (Fig A). MTT and TTP using K-edge of gadolinium and iodine material decomposition images correlated significantly with HU images with a R=0.97 and R=0.99 for MTT and R=0.86 and R=1 for TTP respectively (p<0.05)(Fig B). Thus, increase of MTT from 9.1±0.3 seconds to 10.5±0.1 seconds after dopamine infusion could be quantified on both K-edge gadolinium specific perfusion images and conventional HU Images.

CONCLUSION

SPCCT allows high resolution dynamic dual contrast kidney perfusion imaging and quantification with gamma variate modeling using either conventional HU, iodine and gadolinium K-edge specific imaging.

CLINICAL RELEVANCE/APPLICATION

Spectral photon-counting CT allows to perform renal perfusion assessment using gadolinium K-edge images, iodine images as well as conventional CT images.

SSA10-08 Determination of Single-Kidney Glomerular Filtration Rate (GFR) With CT Urography versus Renal Dynamic Imaging Gates Method

Sunday, Nov. 26 11:55AM - 12:05PM Room: E351

Participants

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PURPOSE

To present a single-kidney CT-GFR measurement by using images from CT urography, and compare it with renal dynamic imaging Gates method (Gates-GFR).

METHOD AND MATERIALS

This prospective study was approved by our institutional review board, and written informed consent was obtained from all patients. Thirty-six patients with hydronephrosis referred for CT urography and the 99mTc-DTPA renal dynamic imaging were prospectively included after informed consent. The CT protocol included non-contrast scan, nephrographic, and excretory phase. The CT-GFR was calculated by dividing the CT number increments of the urinary system between the nephrographic and excretory phase (CTNIurinary-system) by the products of iodine concentration in the aorta and the time (Productsconcentr-time), then multiplied by (1- hematocrit), which was then split into single-kidney CT-GFR and compared with single-kidney Gates-GFR by using paired t-test, correlation analysis, and Bland-Altman plots.

RESULTS

Paired difference between single-kidney CT-GFR (45.02 ± 13.91) and single-kidney Gates-GFR (51.21 ± 14.76) was 6.19 ± 5.63 ml/min, p<0.001, demonstrating 12.1% systematic underestimation with ± 11.03 ml/min ($\pm 21.5\%$) measurement deviation. A good correlation was revealed between both measurements (r=0.87, p<0.001).

CONCLUSION

The proposed single-kidney CT-GFR correlates and agrees well with the reference standard despite a systematic underestimation (12.1%), therefore could be used as an one-stop-shop CT technique for evaluating urinary tract morphology and split renal function without additional radiation dose.

CLINICAL RELEVANCE/APPLICATION

The proposed technique could be used as an one-stop-shop CT technique for evaluating urinary tract morphology and split renal function without additional radiation dose.

SSA10-09 Multiparametric MRI (mpMRI) Of Renal Transplant: Preliminary Results and Repeatability Study in Patients with Stable Renal Function

Participants Octavia Bane, PhD, New York, NY (*Presenter*) Nothing to Disclose Stefanie Hectors, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Sonja Gordic, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Mathilde Wagner, MD, PhD, Paris, France (*Abstract Co-Author*) Consultant, Toshiba Medical Systems Corporation Fadi Salem, New York, NY (*Abstract Co-Author*) Nothing to Disclose Madhav Menon, New York, NY (*Abstract Co-Author*) Nothing to Disclose Sara Lewis, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Bachir Taouli, MD, New York, NY (*Abstract Co-Author*) Consultant, MEDIAN Technologies ; Grant, Guerbet SA Jeff L. Zhang, PhD, Salt Lake Cty, UT (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess feasibility and test-retest repeatability of quantitative mpMRI parameters of diffusion, perfusion and hypoxia in renal transplant (Tx).

METHOD AND MATERIALS

11 patients (M/F 5/6, mean age 57y), 10 with functional renal Tx (estimated MDRD serum eGFR 48-84 ml/min/1.73m2) and 1 with chronic renal dysfunction (GFR 24.6) were prospectively enrolled. All patients underwent mpMRI at 1.5T (Aera, Siemens) including intravoxel-incoherent motion DWI (IVIM-DWI), DTI, BOLD and DCE-MRI renography with injection of 4 ml macrocyclic gadolinium agent (Dotarem). IVIM-DWI and BOLD signal curves, and DTI FA values, were measured from circular ROIs placed at the upper, middle and lower renal Tx poles. IVIM-DWI parameters (true diffusion D, pseudodiffusion D*, perfusion fraction PF and ADC) were obtained by Bayesian fitting. R2* transverse relaxation rate was obtained by monoexponential fit. Volume-averaged concentration-time curves obtained from DCE-MRI data for Cx, Med, and iliac artery were analyzed according to a previously validated three-compartment model to extract GFR, Cx and Med renal plasma flow (RPF) and mean transit time (MTT). Test-retest repeatability was assessed in 5 patients (average scan delay 24d) by coefficient of variation (CV).

RESULTS

IVIM-DWI parameters were highly repeatable (CV<5%), except for PF (CV Cx/Med 7.8%/14.6%) and D* (CV Cx/Med 32.7%/20.3%). R2* and FA had acceptable repeatability (CV<15%). DCE-MRI had acceptable repeatability for GFR (CV 12.18%), and poorer repeatability for RPF and MTT (CV 14-30%). FA Med was significantly higher compared to Cx (0.37 ± 0.08 vs 0.18 ± 0.06 , p=0.0039). Cx RPF was significantly higher compared to Med RPF (433.3±121.6 vs 84.8±20.5 ml/min, p=0.0156). There was no significant correlation between serum eGFR and MRI parameters, between IVIM-DWI or BOLD and DCE-MRI parameters.

CONCLUSION

Quantitative mpMRI is moderately-to-highly repeatable in renal Tx. All parameter values agreed with literature values for patients with functional renal Tx, except for D* and Cx R2*, which were higher than published values.

CLINICAL RELEVANCE/APPLICATION

Knowledge of test-retest repeatability allows identification of differences in mpMRI-derived parameters that reflect intrinsic renal dysfunction rather than normal physiological variation and measurement noise. The value of mpMRI-derived metrics for characterizing renal Tx dysfunction will be investigated in a larger study.





103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA11

Genitourinary (Renal and Adrenal Imaging)

Sunday, Nov. 26 10:45AM - 12:15PM Room: E353B



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

Participants

Chandana G. Lall, MD, Orange, CA (*Moderator*) Nothing to Disclose Erick M. Remer, MD, Cleveland, OH (*Moderator*) Nothing to Disclose

Sub-Events

SSA11-01 Evaluation of Renal Lesions Using Contrast-Enhanced Ultrasound (CEUS): A 10-Year Retrospective Mono-Center Analysis

Sunday, Nov. 26 10:45AM - 10:55AM Room: E353B

Participants

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PURPOSE

To investigate the usefulness of contrast-enhanced ultrasound (CEUS) in the evaluation of renal masses.

METHOD AND MATERIALS

This institutional review board approved retrospective study included a total of 255 patients with a single renal mass with imaging studies between 2005 and 2015. Patient ages ranged from 18 to 86 with (mean age 62 years; $SD \pm 13$). CEUS was used for determining malignancy or benignancy and initial findings were correlated with the histopathological outcome. Out of the 255 renal masses a total of 212 lesions were malignant (83,1%) and 43 were found to be benign (16,9%). Diagnostic accuracy was tested by using the histopathological diagnosis as the gold standard.

RESULTS

CEUS showed a sensitivity of 99.1% (95% confidence interval (CI): 96.7%, 99.9%), a specificity of 80.5% (95% CI: 65.1%, 91.2%), a positive predictive value (PPV) of 96.4% (95% CI: 93.0%, 98.4%) and a negative predictive value (NPV) of 94.3% (95% CI: 80.8%, 99.3%). Kappa for diagnostic accuracy was K= 0.85 (95% CI: 0.75, 0.94) Out of the 212 malignant lesions a total of 130 clear cell renal carcinomas, 59 papillary renal cell carcinomas, 7 chromophobe renal cell carcinomas, 4 combined clear cell and papillary renal cell carcinomas and 12 other malignant lesions, e.g. metastases, were diagnosed. Out of the 43 benignant lesions a total 10 angiomyolipomas, 3 oncocytomas, 8 benignant renal cysts and 22 other benignant lesions, e.g. renal adenomas, were diagnosed. 10 lesions were falsely identified as malignant or benign, whereas 8 lesions were false-positive and 2 lesions false negative. The 8 false-positive lesions included 5 oncocytomas or angiomyolipomas and 3 Bosniak category III cystic lesions.

CONCLUSION

CEUS is an useful method, which can be used to differentiate between malignant and benign renal lesions. In daily clinical routine, patients with contraindications for other imaging methods can particularly benefit using this method.

CLINICAL RELEVANCE/APPLICATION

CEUS can be used in daily clinical routine equipollent tool for the evaluation and diagnosis of renal masses and shows an excellent correlation to the histopathological outcome. In contrast to other imaging modalities like MRI and CT it is an easy, fast and cost-effective modality for the determination of renal masses and should be considered as an alternative for routine use.

SSA11-02 Optimizing Diffusion-Weighted Imaging of the Kidneys: Comparison between Simultaneous Multi-Slice and Integrated Slice-By-Slice Shimming Echo Planner Sequence

Sunday, Nov. 26 10:55AM - 11:05AM Room: E353B

Participants

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PURPOSE

To compare the image quality of diffusion-weighted imaging (DWI) of the kidneys acquired using a simultaneous multi-slice (SMS) and prototypic ss-epi sequence with integrated slice-specific dynamic shimming (iShim) at 3T. The difference in the apparent diffusion coefficient (ADC) was also evaluated.

METHOD AND MATERIALS

In this IRB-approved study, 28 subjects including 22 patients (9 with chronic kidney disease, 4 with Gitelman syndrome, 7 with IgA nephropathy, 2 with malignant hypertension) and 6 healthy volunteers underwent DWI of the kidneys at 3T using the SMS DWI sequence with CAIPIRINHA unaliasing technique and prototype ss-epi sequence with iShim. A TSE-T2WI sequence was acquired to evaluate the geometric distortion of DW images. The SNR, CNR, and ADC calculated by using five b-values (0, 80, 400, 800, and 1600s/mm2) of the kidney were measured. The coordinates of anatomic points of the anterior margins of both kidneys, the posterior angle of spinal canal, the middle posterior point of erector spinae were selected and the length between each pair of matched anatomic points from the TSE-T2WI and b0 maps of EPI were calculated by using an in-house developed software program. Subjective image quality was evaluated by two radiologists on a 5-point scale, and the presence of artifacts was recorded for each sequence. Acquisition time (AT) of the two sequences was also compared.

RESULTS

No statistical differences in the SNR and CNR of all the b-values were observed between SMS and iShim DWI (P>0.05). ADCs in the kidneys were comparable in the SMS and iShim sequences (1552.6±140.2 vs. 1543.3±170.7, P>0.05). Compared to iShim, the length of distortion in SMS sequence is smaller in phase direction (2.11±1.19 vs 2.87 ± 1.70 pixel) but larger in read direction (3.12±1.04 vs 2.87 ± 1.71 pixel). The total length of distortion in SMS sequence is significantly smaller (3.87 ± 1.23 vs 15.20 ± 0.98 pixel, P<0.001). The AT was substantially decreased in SMS compared to iShim DWI (3:56 vs 8:28 min). Subjective image quality scores were not statistically different between the two sequences for both reviewers (SMS vs iShim, reviewer 1: 4.36 ± 0.68 vs. 4.32 ± 0.67 , reviewer 2: 4.54 ± 0.64 vs. 4.29 ± 0.81 , P > 0.05). Significantly fewer artifacts were observed in SMS DWI (8 vs. 21, P < 0.001).

CONCLUSION

Compared with the iShim DWI sequence, SMS DWI substantially reduced AT, distortion and artifacts while maintaining image quality and the stability of ADC values in kidney DWI.

CLINICAL RELEVANCE/APPLICATION

By considerably reducing the AT, distortion and artifacts while preserving image quality, SMS DWI may contribute to a more efficient and safer workflow in clinical practice.

SSA11-03 Noise Matters: Correction for Imaging Parameters Improves Performance of a Gaussian-Based Adrenal Nodule Characterization Algorithm

Sunday, Nov. 26 11:05AM - 11:15AM Room: E353B

Participants

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PURPOSE

Histogram analysis (HA) of indeterminate adrenal nodules has shown good sensitivity and high specificity for differentiating adenomas from nonadenomas, but requires post-processing that can hinder workflow. A Gaussian-based algorithm (GA) based on HA without the need for post-processing demonstrated similar performance. We sought to determine if normalizing noise can improve diagnostic performance of the GA in a biopsy-enriched sample of patients with either a history of cancer or a high risk of cancer.

METHOD AND MATERIALS

IRB-approved, HIPAA-compliant retrospective study evaluated 71 adrenal nodules (41 biopsied) on non-contrast CT using the GA based on region of interest histogram analysis with and without noise correction (normalization of effective mAs and slice thickness to published data). Two independent readers were blinded to final pathology. Lesions were characterized as malignant if biopsy-proven or likely benign due to pathology or imaging features (stability > 1 year, adrenal CT washout, MRI signal loss, or negative FDG PET/CT with a FDG positive primary). 66/71 patients had a history of cancer and 5 were high-risk patients. Inter-reader agreement was assessed using intraclass correlation coefficient (ICC) and Cohen's kappa. Sensitivity, specificity, and accuracy were compared between algorithms using the bootstrap.

RESULTS

Mean size of the adrenal nodules was 3.0 cm \pm 2.0. 35 biopsied nodules were metastases. Of the 36 benign nodules, 6 were characterized by pathology and 30 by imaging. Inter-reader agreement was good for mean and s.d. of nodule attenuation (ICC=0.91-0.97) and identification of adenoma by both GAs (kappa=0.84-0.88). The GA with correction had significantly increased overall accuracy for adenoma than the non-corrected GA (79% vs. 64%, p=0.005), with higher specificity (87% vs. 46%, p<0.001) and a trend toward lower sensitivity (71% vs. 82%, p=0.07).

CONCLUSION

A Gaussian-based algorithm based on histogram analysis can be used to differentiate adenomas from non-adenomas without post processing; however, it is important to correct for imaging parameters to improve the performance of the algorithm.

CLINICAL RELEVANCE/APPLICATION

Correction for imaging parameters improves performance of a Gaussian-based adrenal nodule characterization algorithm for distinguishing adenomas from non-adenomas without additional post processing.

SSA11-04 Utility of Texture Analysis for Differentiation of Solid Adrenal Lesions

Sunday, Nov. 26 11:15AM - 11:25AM Room: E353B

Participants

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PURPOSE

Incidentally noted adrenal nodules are commonly encountered in clinical practice. While many prove to be benign on follow up imaging, some lesions remain indeterminate and result in more invasive workup, such as biopsy. To this end, the purpose of this study was to evaluate the utility of texture analysis for differentiation of lipid poor adenomas from other solid adrenal tumors on contrast enhanced computed tomography (CT).

METHOD AND MATERIALS

In this IRB approved study, patients with a contrast enhanced CT prior to a CT-guided adrenal biopsy between 2006 and 2014 were included. Texture analysis was performed using a commercially available research software program (TexRAD) that applies a filtration-histogram technique for characterizing tumor heterogeneity. The filtration step selectively filters and extracts texture features at different anatomical scales varying from 2mm (fine features) to 5mm (coarse features). Receiver operating characteristics (ROC) curve analysis was performed to assess sensitivity and specificity for differentiating between benign and malignant lesions.

RESULTS

Of the 124 lesions included for analyses, 43 were benign and 81 malignant. Amongst the unfiltered texture features, standard deviation, entropy and skewness were excellent discriminators of lesions demonstrating areas under the curve (AUC) greater than 0.9 (p<0.0001). Of these, entropy was the best parameter for discrimination of lesions with an AUC of 0.95. Using a threshold value of 4.42, entropy had a sensitivity and specificity of 95% and 88%, respectively, for differentiating lesions. Amongst the filtered texture features, entropy was the best discriminator of lesions with an AUC of 0.97 (p<0.0001). Using a threshold value of 4.83, the sensitivity and specificity for differentiating lesions were 81% and 100%, respectively. Mean positive pixel (MPP) was an excellent discriminator of lesions across different spatial filter sizes with AUCs ranging from 0.89 to 0.92 (p<0.0001).

CONCLUSION

Results demonstrate the effectiveness of texture analysis as a radiomic marker for characterizing incidentally noted adrenal nodules.

CLINICAL RELEVANCE/APPLICATION

The growing use of CT has led to an increase in detection of incidental adrenal lesions. Use of texture analysis to characterize such lesions may reduce the need for follow up imaging and/or invasive tissue sampling.

SSA11-05 Usefulness of CT Texture Analysis in Characterizing Renal Cancers

Sunday, Nov. 26 11:25AM - 11:35AM Room: E353B

Participants

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PURPOSE

Pre-surgical characterization of renal cancer histology and grade help to decide on treatment options, e.g., radical nephrectomy, nephron-sparing surgery, ablation or, in some cases, observation. We wanted to investigate the value of CT texture analysis (CTTA) in differentiating clear cell renal cancer (CCRCC) from papillary renal cell cancer (PRCC) and predicting the Fuhrman grade.

METHOD AND MATERIALS

In this retrospective institutional review board-approved, HIPAA-compliant study, 249 patients with CCRCC and 49 patients with PRCC who had pretreatment contrast-enhanced CT were identified from the pathology and radiology databases. The axial enhanced CT image of largest tumor cross section was uploaded to a cloud server with CTTA software (TexRad v3.9, Cambridge, UK). The maximum tumor diameter was recorded and texture analysis parameters of mean, entropy, kurtosis, maximum positive pixel (MPP) and skewness were determined using different spatial scaling factors (SSF 0-6). Logistic regression analysis was performed to determine if the CTTA parameters or tumor size correlated with the tumor histology and Fuhrman grade. Receiver operating

RESULTS

There was no significant difference in age, or maximum tumor diameter between the CCRCC and PRCC groups (p=0.076 and 0.936, respectively). Entropy with medium (SSF3) and coarse filters (SSF5) were significantly higher in CCRCC than PRCC (p=0.05 for both). High Fuhrman stage (3 & 4) cancers were associated with larger tumor diameter and high entropy value with coarse filter (SSF6) (p<0.001 and p=0.001, respectively). The area under ROC curve (AUC) of entropy at SSF3 and SSF5 were 0.843 (0.782-0.905) and 0.841 (0.780-0.902), respectively, for differentiating CCRCC from PRCC. Entropy greater than 5.36 at coarse filter (SSF5) had sensitivity and specificity of 74% and 88%, respectively, for CCRCC.

CONCLUSION

The CTTA parameter of entropy at coarse spatial scaling filter may help to differentiate CCRCC from PRCC and to predict the Fuhrman stage.

CLINICAL RELEVANCE/APPLICATION

CTTA parameters may help to determine tumor biology and change management in some cases.

SSA11-06 Progression (Upgrade) Rate of Followed Bosniak Category IIF Complex Renal Cysts

Sunday, Nov. 26 11:35AM - 11:45AM Room: E353B

Participants

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PURPOSE

To evaluate progression (upgrade) rate of followed Bosniak category IIF complex renal cysts and malignancy rate on surgically resected lesions.

METHOD AND MATERIALS

This was an institutional review board-approved retrospective study. Imaging department database system was searched from January 1, 2008, to April 1, 2016, for Bosniak category IIF complex renal cysts found on contrast enhanced computed tomography or magnetic resonance imaging. Exclusion criteria were lesions smaller than 1.0 cm or without follow-up study. Stability of Bosniak category IIF lesions required a minimum of 6 months follow-up. Progression was considered when the follow-up study indicated upgrade of Bosniak category to III or IV. Pathologic results were evaluated in patients submitted to surgery and follow-up to look for recurrent or metastatic disease.

RESULTS

A total of 152 lesions (size range, 1-16 cm; average 3 cm) in 143 patients (107 men, 36 women; age-range, 31-94 years; average, 63 years) were included in the final analysis. Follow-up studies were performed from 6 to 118 months (average 28 months). Seven of 152 lesions (4.6%) progressed to Bosniak category III or IV on follow-up studies in one month to 4 years (average 20 months). Three of those were surgically removed, all of them diagnosed as malignant renal cell carcinoma (one clear cell and two papillary subtypes). Follow-up after surgery ranged from 16 to 30 months (average 24 months) and there was no evidence of recurrence or metastasis. From the remaining, one patient with Bosniak category III lesion had concomitant hepatocellular carcinoma and the renal lesion showed stability in one year-follow-up; and two patients lost follow-up in our institution.

CONCLUSION

Progression rate occurred for 4.6% of followed Bosniak category IIF lesions in one month to 4 years. All resected lesions were diagnosed as renal cell carcinomas.

CLINICAL RELEVANCE/APPLICATION

Although Bosniak category IIF cysts have low upgrade rate on follow-up studies, all surgically resected lesions were malignant neoplasms.

SSA11-07 Fat Quantification of Adrenal Masses Using 3D 6-point Dixon MR Imaging: Intermodality Agreement and Interobserver Reproducibility Study

Sunday, Nov. 26 11:45AM - 11:55AM Room: E353B

Participants

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PURPOSE

Three-dimensional (3D) 6-point Dixon fat fraction (DFF) techniques may enable fat quantification of adrenal masses. The purpose of this study was to assess the intermodality and interobserver agreement of fat quantification of adrenal masses obtained with 3D 6-point DFF imaging and two-dimensional (2D) dual-echo chemical shift GRE imaging (CSI).

METHOD AND MATERIALS

Two radiologists independently measured fat fraction in 27 mass lesions of 19 patients with adrenal masses. The adrenal lesions included 17 adrenal adenomas, 6 ACTH-independent macronodular adrenal hyperplasias, 2 metastatic adrenal tumors, 1 pheochromocytoma, and 1 myelolipoma. The CSI and DFF MR imaging were performed with a 3.0-T MR system. Quantitative measurements of signal intensity (SI) changes between in-phase and opposed-phase images were computed as follows: SI index = (SIin-SIop)/SIin, where SIin is SI on in-phase images and SIop is SI on opposed-phase images. Quantitative measurement of DFF was automatically calculated by proton density fat fraction (PDFF) maps. They placed regions of interest (ROI) in the mass on CSI and PDFF maps. Intermodality and interobsever agreement were determined by using 95% Bland-Altman limits of agreement and intraclass correlation coefficients (ICCs).

RESULTS

The intermodality agreement for fat quantification was good on CSI and PDFF maps; ICCs ranged from 0.62 to 0.64. The 95% limits of agreement ranged from 81.6% to 84.8%. ICCs for interobserver agreement in CSI and PDFF were 0.998 and 0.982, respectively. The 95% limits of agreement were 9.6% for CSI and 9.6% for PDFF.

CONCLUSION

In fat quantification of adrenal masses, 3D 6-point DFF technique at 3T yielded measurements and reproducibility similar to those of 2D dual-echo CSI.

CLINICAL RELEVANCE/APPLICATION

For fat quantification of adrenal masses on 3T MRI, 3D 6-point DFF technique is as useful as 2D dual-echo CSI.

SSA11-08 Subtype Differentiation of Small (< 4 cm) Solid Renal Mass Using Volumetric Histogram and Texture Analysis of Reduced Field-of-View Diffusion Weighted MRI at 3-T

Sunday, Nov. 26 11:55AM - 12:05PM Room: E353B

Participants

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PURPOSE

To evaluate the utility of volumetric histogram and texture analysis originated from reduced field-of-view (r-FOV) diffusion-weighted (DW) imaging for small (< 4 cm) solid renal mass subtypes at 3-T MR.

METHOD AND MATERIALS

In this institutional review board approved study, 70 patients with renal tumors were included in this retrospectively study. Volumetric apparent diffusion coefficient (ADC) maps were generated using all slices of the r-FOV DWI to obtain histogram and texture parameters, including the mean ADC, median ADC, 10th, 25th, 75th, 90th percentiles ADC, standard deviation (SD), skewness, kurtosis and entropy. Comparisons of above parameters were used by one-way analysis of variance, Student's t test and receiver operating characteristic (ROC) curves analysis.

RESULTS

A total of 70 pathologically proven renal tumors including 38 clear cell (ccRCC), 8 papillary (pRCC), 6 chromophobe (chRCC), 13 minimal fat angiomyolipoma (MFAML) and 5 oncocytoma (Onc) were enrolled in our analysis. The mean ADC, median ADC, 75th, 90th percentiles ADC of ccRCC was significantly higher than pRCC, chRCC, MFAML and Onc (all P < 0.001). The SD of Onc was significantly lower than that of ccRCC and pRCC (P = 0.015, 0.025, respectively). The entropy of MFAML was significantly lower than that of ccRCC and pRCC (P = 0.001, 0.009, respectively), and entropy of Onc was significantly lower than that of ccRCC, pRCC, and chRCC (P = 0.001, 0.004, 0.048 respectively). Mean ADC, median ADC, 10th, 25th, 75th, 90th percentiles ADC, SD and entropy of malignant tumors were significantly higher (all P < 0.001) than those of benign tumors. The 90th percentiles ADC achieved the highest AUC (0.814; 95% CI: 0.713, 0.916) in differentiating malignant renal tumors from benign ones.

CONCLUSION

Our study demonstrated the combination of r-FOV DWI and volumetric histogram and texture analysis of ADC values may have a certain value to help differentiate the majority of subtypes of small solid renal tumor, including benign and malignant lesions.

CLINICAL RELEVANCE/APPLICATION

Quantitative volumetric ADC histogram and texture analysis may have the potential to preoperatively characterize various subtypes of small solid renal tumors, which could ensure proper management options for patients.

SSA11-09 Prospective Evaluation of CT Size and Attenuation Measurement Agreement as Applied to Tumor Response Assessment in Metastatic Renal Cell Carcinoma Patients from Phase II of the Multi-Centre STAR Trial

Sunday, Nov. 26 12:05PM - 12:15PM Room: E353B

Participants

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PURPOSE

Response assessment in the setting of anti-angiogenic therapies is challenging due to discrepancies in tumor devascularisation versus shrinkage. Assessment of both tumor size and enhancement change may be more valid but requires robust methodology. We aimed to prospectively assess the level of observer agreement relating size and absolute versus normalised enhancement at different post-contrast phases in metastatic renal cell cancer.

METHOD AND MATERIALS

Following IRB approval and informed consent, 104 target lesions in 44 patients enrolled in a prospective multicentre phase II/III trial comparing tyrosine kinase inhibitor treatment strategies in metastatic renal cell carcinoma were measured by two radiologists at baseline and 12 week follow-up CT. Percentage change in sum of TL longest diameters and percentage change in tumor enhancement, assessed both in the arterial and portal venous phases, and with normalised values relative to aortic attenuation were noted for each observer using semi-automated commercial software. Agreement between readings was assessed by intraclass correlation coefficients (ICC) and Bland-Altman plots.

RESULTS

Excellent inter-rater agreement was seen for target SLD measurements ICC 0.93[0.88-0.96] mean difference 1.68, 95% LOA [-39.22-42.58] with good agreement for percentage size change at follow up 0.60[0.38-0.76]1.52[-31.98-35.03]. Moderate agreement was seen for absolute and normalised mean arterial enhancement values 0.42[0.13-0.65]-9.8[-102.6-83.4], 0.58[0.33-0.76]-5.2[-49.3-38.9] with good agreement for percent change respectively 0.72[0.52-0.85], -5.2[-49.3-38.9] 0.89[0.79-0.94]-0.3[-29.1-29.4]. Agreement was higher for absolute 0.78[0.62-0.88], 2.9[-30.6-36.4] and normalised mean venous enhancement values 0.63[0.38-0.79], 0.04[-0.39-0.43] and percent change: 0.89[0.798-0.947]-0.33[-29.13-29.4], 0.79[0.62-0.89]2.9[-38-43.8].

CONCLUSION

Excellent agreement was noted for size change with moderate to good agreement for enhancement characteristics. Normalised enhancement values improved observer agreement which was higher for the venous phase. Concordance for percentage change in normalised enhancement was good irrespective of enhancement phase.

CLINICAL RELEVANCE/APPLICATION

Good to excellent inter-observer agreement for normalised tumor enhancement values is a further step to achieving more robust response evaluation of angiogenic tumors with size and enhancement criteria.







SSA12

Science Session with Keynote: Informatics (Artificial Intelligence and Deep Learning in Medical Imaging)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S403A

IN

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

Participants

George L. Shih, MD, MS, New York, NY (*Moderator*) Consultant, Image Safely, Inc; Stockholder, Image Safely, Inc; Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;

Safwan Halabi, MD, Stanford, CA (*Moderator*) Nothing to Disclose Norio Nakata, MD, Tokyo, Japan (*Moderator*) Nothing to Disclose

Sub-Events

SSA12-01 Informatics Keynote Speaker: Emerging Trends in Medical Artificial Intelligence

Sunday, Nov. 26 10:45AM - 10:55AM Room: S403A

Participants

Norio Nakata, MD, Tokyo, Japan (Presenter) Nothing to Disclose

ABSTRACT

Artificial intelligence (AI) including deep learning (DL) and natural language processing (NLP) is one of key topics for future radiology. DL, which is a class of machine learning algorithms, has produced breakthrough results in many areas including image recognition recently. Ideally, conventional deep learning methods in radiology require large amount s of supervised datasets, such as over thousands of diagnostic images and collect answers. So large scale of medical image databases have been built in many institutions throughout the world. Recent advantage in AI shows more efficient and improved methods of transfer learning and reinforcement learning. Automated image captioning with deep learning opens up the possibility of collaborative reporting workflows by AI and radiologists. A classification system of automated driving based on six different levels (ranging from none to fully automated systems) was published in 2014 by Society of Automotive Engineers (SAE). Similar AI classifications in radiology is proposed as follows: level 0. Image preprocessing without AI; level 1. One simple image recognition; level 2. Complex image recognitions at multiple points; level 3. Image diagnosis equivalent to human being; level 4. Image diagnosis beyond human being (i.e. image recognition of MRI k-space data).

SSA12-02 Automated Risk Stratification of Suspicious Lung Nodules Using 3D Convolutional Neural Network with Modified Network-In-Network Architecture

Sunday, Nov. 26 10:55AM - 11:05AM Room: S403A

Participants

Jae Ho Sohn, MD, San Francisco, CA (*Presenter*) Nothing to Disclose Alex Izvorski, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Thienkhai H. Vu, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Dexter Hadley, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

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CONCLUSION

An automated algorithm was developed to predict risk of malignancy given a suspicious lung nodule, achieving overall AUC of 0.892 and log-loss of 0.424.

Background

Accurate prediction of lung nodules' malignancy risk has important clinical implications for treatment and diagnostic decisions. There are established imaging features to identify definitively benign nodules, but accurate stratification of intermediate to high risk nodules remains challenging. Using a 3D convolutional neural networks (CNN), we developed an algorithm to automatically analyze the risk of malignancy for a given suspicious lung nodule.

Evaluation

This study included 1600 patients from the National Lung Cancer Screening Trial (NLST) with 324 biopsy-proven lung cancer and 180 suspicious but confirmed benign lung nodules. Nodule location and diameter were manually annotated by a radiology resident under the supervision of a chest radiology attending. We designed an 18-layered 3D classifier neural network inspired by the Network-in-Network architecture, further modified to include batch normalization and dropouts. Transfer learning was conducted via pre-trained weights from an in-house nodule localizer. Briefly, the localizer network uses artificial nodule generation followed by a modified fully convolutional network approach to localize medium to high risk nodules. Our classifier network used binary cross-entropy loss function, ADAM optimizer, learning rate of 0.001, and batch size of 64. Data augmentation was conducted to generate

409,600 samples. Training time took 3.3 hours on NVIDIA GTX 1080. Final model achieved log-loss of 0.424 and AUC of 0.892. Error analysis was conducted with examples of confident corrects, confident incorrects, and random cases.

Discussion

We demonstrate a 3D deep learning algorithm that can automatically assess a lung nodule's risk of malignancy. If externally validated, this algorithm can address an important need for risk stratification of lung nodules in category of intermediate to high risk for malignancy. Of note, the algorithm still has capacity for improvement by using the entire NLST cohort and conducting hyperparameter optimization.

SSA12-03 Convolutional Neural Network in Differentiating Head MRIs from Other Methods in Diagnostic Imaging

Sunday, Nov. 26 11:05AM - 11:15AM Room: S403A

Participants

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CONCLUSION

To date, there is no open-source, labeled medical imaging dataset comparable to ImageNet because the acquisition of these images is too laborious and expensive. However, AlexNet proved to be a powerful tool for sorting head MRI from other imaging modalities. This concept could be expanded to other exam types, in order to create an unblended dataset for further use in deep learning medical applications

Background

Convolutional neural network is an artificial intelligence technique capable of learning on its own to recognize an image through its features and similarities, and has been used to enhance human capabilities in many fields, including diagnostic imaging. The biggest challenge in training a neural network for any utilization is to obtain a large-scale database of properly labeled images that the neural network can use to learn. The largest know database of labeled images is ImageNet, which contains more than 15 million natural images (not medical) collected from the web, but there is no comparable source of medical images available due to several difficulties in data labeling. One of these difficulties arise from the lack of standardization for the names of studies in DICOM metadata. This study's purpose is to train a neural network to differentiate head MRIs from other imaging modalities, and test its accuracy in order to create a medical dataset of high definition, properly sorted images that could be used in further researches applying deep learning in medical applications

Evaluation

Up to 358,180 anonymized studies were split into two groups, the first one containing only head MRIs (67,374 images), and the second one composed of MRIs of other body parts and different diagnostic modalities such as radiographs, ultrasound and computed tomography (290,806 images). This dataset was randomized into training (70%), validation (20%) and test (10%) subsets. AlexNet was trained from scratch using stochastic gradient descent, with sigmoid decay of the initial training rate of 0.01 in 60 epochs.

Discussion

In the present study, AlexNet achieved 99.8% top-1 accuracy for differentiating head MRIs from other exams, with a loss of 0.00012 for the training subset and 0.004 for the validation subset

SSA12-04 Automated Detection and Classification of Pediatric Urinary Tract Dilation (Hydronephrosis) with Convolutional Neural Networks

Sunday, Nov. 26 11:15AM - 11:25AM Room: S403A

Participants Alex K. Bratt, MD, New York, NY (*Presenter*) Nothing to Disclose Liana Greer, New York, NY (*Abstract Co-Author*) Nothing to Disclose Daniel G. Rosenbaum, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose James Shin, MD, MSc, New York, NY (*Abstract Co-Author*) Nothing to Disclose Ranjit S. Sandhu, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose George L. Shih, MD, MS, New York, NY (*Abstract Co-Author*) Nothing to Disclose George L. Shih, MD, MS, New York, NY (*Abstract Co-Author*) Consultant, Image Safely, Inc; Stockholder, Image Safely, Inc; Arzu Kovanlikaya, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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CONCLUSION

Deep learning may be suitable for detecting the presence and extent of UT dilation in children. We take a first step in this direction and show a path for future work.

Background

Early detection and management of urinary tract (UT) dilation in children is necessary to prevent the development of future uropathies. Ultrasound (US) is the primary modality for the diagnosis and grading of UT dilation; however, despite ongoing attempts at creating consensus-based reporting parameters and lexicon, pediatric renal US remains prone to substantial inter- and intraobserver variability. Thus, an automated system could be helpful for standardization. To this end, we propose a semi-automated system for detecting the presence and degree of UT dilation on renal US using deep learning. To our knowledge, this is the first work of its kind.

Evaluation

We developed two deep neural networks for UT dilation classification: one is a binary classifier trained to detect the presence or absence of UT dilation. The other grades UT dilation on a scale of 0-2 based on the extent of calyceal dilation (no calyceal dilation, central calyceal dilation, or peripheral calyceal dilation). The preliminary dataset consists of single sagittal renal US images split into a training set containing 609 samples and a test set containing 71 samples. After training the binary classifier had a test set accuracy of 94% and area under the curve 0.96. The multi-label classifier had an accuracy of 85% and Cohen's kappa coefficient 0.75.

Discussion

We demonstrate a highly accurate binary classifier for pediatric UT dilation using deep neural networks. Our multi-label classifier performs somewhat worse than the binary classifier though it approaches published values of intra- and interobserver variability based on Cohen's kappa. We speculate that the relatively poor performance of the multi-label classifier stems from the small size of our dataset. Future work will focus on incorporating a larger and more diverse data stream so the model may be evaluated against standard classification schemes such as the UTD classification system. Our goal is to integrate the classifier into clinical workflow to improve standardization and diagnostic accuracy.

SSA12-05 Cardioblaster: Determination of Clinical Cardiac Parameters from Short-Axis MRI Scans using Deep Learning

Sunday, Nov. 26 11:25AM - 11:35AM Room: S403A

Participants

Hinrich B. Winther, MD, Hannover, Germany (*Presenter*) Nothing to Disclose Christian Hundt, DIPLPHYS,PhD, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose Bertil Schmidt, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose Christoph P. Czerner, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose Frank K. Wacker, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose Jens Vogel-Claussen, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To establish fully automated determination of clinical cardiac parameters on 2D short axis cine MRI stacks using deep learning and to compare the results with human expert performance.

METHOD AND MATERIALS

Clinical cardiac parameters are of great importance for early detection and therapy monitoring of ischemic and non-ischemic heart disease. Manual determination of these parameters takes experts more than 20 minutes (Caudron et al.2012). Furthermore, Caudron et al. (2012) reports the following intraclass correlation coefficient (ICC) values for two human experts: ESV 99/92, EDV 99/89, VM 85/54, SV 87/81, EF 95/80. A training set, consisting of 253 manually segmented cardiac MRIs of a in house (n=193) and the Data Science Bowl Cardiac Challenge (n=60) data set, was assembled. Validation was performed on a in house (n=309), the Data Science Bowl Cardiac Challenge (n=602), the MICCAI 2009 LV Segmentation Challenge (n=44), and the Right Ventricular Segmentation Challenge (n=32) data sets. The neural network was implemented in TensorFlow. End systolic volume (ESV), end diastolic volume (ESV), ventricular mass (VM), ejection fraction (EF), and stroke volume (SV) for the left (LV) and right ventricle (RV) were calculated using Python.

RESULTS

The ICC between the automated segmentation and the ground truth is: ESV 92-96/92-96 (LV/RV/ in %), EDV 94-99/92-96, VM 94-95/83-83, SV 90-98/84-92, EF 80-98/87-96 for the four distinct data sets. Caudron et al. (2012) reports the following ICC values for two human experts: ESV 99/92, EDV 99/89, VM 85/54, SV 87/81, EF 95/80.

CONCLUSION

This study demonstrates a reliable method for automatically determining clinical cardiac parameters such as ESV, EDV, EF, SV and VM. The ICC results show a comparable or higher performance in comparison to human experts, especially in the RV. Furthermore, we applied the concept of transfer learning of a pre-trained neural network to a new environment. This effectively eliminates the associated costs in introducing a neural network in a new setting.

CLINICAL RELEVANCE/APPLICATION

Introducing a neural network in the routine clinical workflow of cardiac MR image analysis. Transfer learning could effectively eliminate the associated time and cost in the future.

SSA12-06 Generating Heatmaps to Visualize the Evidence of Deep Learning Based Diagnosis of Chest X-Rays

Sunday, Nov. 26 11:35AM - 11:45AM Room: S403A

Participants

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PURPOSE

For radiologists to develop confidence in a deep learning diagnostic algorithm, it is essential that the algorithm be able to visually demonstrate the evidence for the diagnosis or disease tag. We describe the development of a method that highlights the region(s) of a chest X-ray (CXR) responsible for a deep learning algorithm diagnosis.

METHOD AND MATERIALS

Using 24,384 CXRs, we trained 18-layer deep residual convolutional neural networks to predict if a chest X-ray was normal or abnormal, and to detect the presence of 'cardiomegaly, 'opacity', and 'pleural effusion' in a CXR. We then applied a method called prediction difference analysis for visualization and interpretation of the trained models. The contribution of each patch in the image is estimated as the degree by which the prediction changes if that patch is replaced with an average normal patch. This method was used to generate a relevance score for each pixel which is consequently visualized as a heat map.

RESULTS

We used a 60-20-20 split for train, validation and test sets. The trained neural network showed an area under the ROC curve of 0.89, 0.92, 0.84, 0.91 for tagging abnormal, cardiomegaly, opacity and pleural effusion respectively on the test set. The visualization pipeline is used to generate heatmaps highlighting the enlarged heart, opacities and the fluid corresponding to the cardiomegaly, opacity and pleural effusion tags.

CONCLUSION

We trained and tested a deep learning algorithm which accurately classifies and assigns clinically relevant tags to CXRs. Further, we applied a visualization method that generates heatmaps highlighting the most relevant parts of the CXR. The visualization method is broadly applicable to other kinds of X-rays, and to other deep learning algorithms. Future work will focus on formally validating the accuracy of the visualization, by measuring overlap between radiologist annotation and algorithm-generated heatmap.

CLINICAL RELEVANCE/APPLICATION

Heatmaps highlighting evidence for disease tags will provide clinical users with crucial visual cues that could ease their decision to accept or reject a deep learning based chest x-ray diagnosis.

SSA12-07 Assessment of Critical Feeding Tube Malpositions on Radiographs Using Deep Learning

Sunday, Nov. 26 11:45AM - 11:55AM Room: S403A

Awards

Trainee Research Prize - Medical Student

Participants Varun Singh, BS, Philadelphia, PA (*Presenter*) Nothing to Disclose Paras Lakhani, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Assess the efficacy of deep convolutional neural networks (DCNNs) in detection of critical enteric feeding tube malpositions on radiographs.

METHOD AND MATERIALS

555 de-identified HIPAA compliant frontal view chest and abdominal radiographs were obtained, consisting of 147 (147/555, 26.5%) x-rays of bronchial insertions and 408 (408/555, 73.5%) non-critical x-rays, including normal course, normal chest, and normal abdominal x-rays. The ground-truth classification for enteric feeding tube placement was performed by two board-certified radiologists. The radiographs were fed into the AlexNet deep convolutional neural network, which included models untrained and that pretrained on ImageNet. The Caffe framework was utilized. Images were split into training (396/555, 71.4%), validation (44/555, 7.9%), and test (115/555, 20.7%). The training dataset was augmented and increased in size to 6336 images, using a combination of rotations, non-rigid transformation, and contrast-limited adaptive histogram equalization (CLAHE). Receiver operating characteristic (ROC) and area-under-the-curves (AUC) on the test data were use to assess the models. Statistical differences among the AUCs were obtained. P < 0.05 was considered statistically significant.

RESULTS

The pre-trained AlexNet algorithm had an AUC of 0.84 (95% CI: 0.65-0.84) and the untrained AlexNet had an AUC of 0.75 (95% CI: 0.75-0.91). The difference between the performance of the algorithms was statistically significant (p=0.049).

CONCLUSION

DCNN's are promising in classifying critical vs. non-critical feeding tube placements with an AUC of 0.84. Networks pre-trained on over one million everyday color images outperformed untrained networks (p=0.049), demonstrating the utility of transfer learning in medical imaging. More training data, pre-processing techniques, and other neural network architectures could further improve these results.

CLINICAL RELEVANCE/APPLICATION

DCNNs may allow for more rapid identification and communication of critical feeding tube malpositions.

SSA12-08 Nodule Slice Detection Based on Weak Labels of Lung CT

Sunday, Nov. 26 11:55AM - 12:05PM Room: S403A

Participants Rongguo Zhang, Beijing, China (*Abstract Co-Author*) Employee, Infervision Inc Yufeng Deng, Durham, NC (*Presenter*) Employee, Infervision Inc Kai Liu, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose Shiyuan Liu, PhD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose Liming Xia, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose Jianlin Wu, MD, Dalian, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Early detection of lung nodules is essential to the diagnosis and treatment of lung cancer. In this paper, the authors proposed an improved method to automatically identify the slices that contain lung nodules from a computed tomography (CT) volume. This deep learning based method aims to serve as a tool for fast screening of lung nodules, in order to reduce CT reading time for radiologists.

METHOD AND MATERIALS

The proposed deep learning model combines convolutional neural networks (CNN) and variable length bidirectional long short term memory networks (LSTM). It relies on a supervised learning approach that only requires weak labels on the training dataset. The labels indicate the CT slices that contain a nodule, but not the exact location of the nodule. The proposed method was evaluated on two datasets with 5-folds cross-validation. Dataset (1) was collected from two 3A grade hospitals in China. It contained 1726 CT volumes (half normal, half contain nodules). Each volume was labeled by at least three radiologists with more than five years of experience. Dataset (2) was the publicly available LIDC-IDRI database containing 888 scans, which underwent a two-phase annotation process by four experienced radiologists.

RESULTS

From dataset (1), our method reached high detection sensitivity of 88.2% and 0.5 false positives per CT volume. From dataset (2), we achieved a high sensitivity of 86.9% with an average of 0.8 false positives per subject, which outperformed the best results (sensitivity 86.4%) in LUng Nodule Analysis (LUNA16) nodule detection challenge on the same dataset.

CONCLUSION

The results demonstrated that the proposed method achieved high sensitivity and specificity in identifying CT slices that contain lung nodules. This deep learning model was shown to outperform the existing computer-aided diagnosis methods with higher sensitivity. The proposed method has promising potential in reducing CT reading time for radiologists, and it only requires weak labels on the training data for easy implementation.

CLINICAL RELEVANCE/APPLICATION

We developed a new method using deep learning networks to detect lung CT slices where the nodules located in, which can assist the radiologists to read CT and reduce their reading time.

SSA12-09 Automated Detection of Large Pneumothoraces on Chest Radiography Using Deep Convolutional Neural Networks

Sunday, Nov. 26 12:05PM - 12:15PM Room: S403A

Participants

Paras Lakhani, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose Adam E. Flanders, MD, Narberth, PA (*Abstract Co-Author*) Nothing to Disclose Raja Gali, MS, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose Baskaran Sundaram, MRCP, FRCR, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose Vijay M. Rao, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Assess the efficacy of deep convolutional neural networks (DCNNs) in differentiating large pneumothoraces (PTXs) from radiographic controls, including normals, bullous disease, and resolved PTXs.

METHOD AND MATERIALS

644 de-identified HIPAA compliant frontal view chest radiographs (CXRs) were obtained, consisting of large PTX (311/644, 48.3%) and radiographic controls (333/644, 51.7%). Images were verified by 2 board certified radiologists, using British Thoracic Society guidelines for classifying PTXs (>2cm depth from chest wall). Controls were CXRs consisting of extensive bullous disease (n=119), resolved PTXs (n=102), and normals (n=108). Three DCNN architectures were assessed-ResNet-34, Inception V1 and AlexNet-using two frameworks (Torch and Caffe), using pre-trained (from ImageNet) and untrained networks. Data-augmentation was used to increase the training dataset size 48-fold, including quadrilateral rotations, translation, shearing, and contrast-enhancement. Images were split into training (480, 74.5%), validation (64/644, 10%), and test (100/644, 15.5%). Receiver operating characteristic (ROC), area-under-the-curves (AUC) on the test data, and ensembles of the algorithms were performed. Statistical differences among the AUCs were obtained. P < 0.05 was considered statistically significant.

RESULTS

The best performing algorithm had an AUC of 0.96 (95% CI: 0.92-1.00), sensitivity 94.0%, and specificity 88.0% for distinguishing

PTXs from controls, which was an ensemble of 6 different algorithms, consisting of pretrained and untrained networks. The model was perfectly accurate in distinguishing normal radiographs from large PTXs (100%). However, false positives included 2 with bullous disease, and 4 with resolved PTXs.

CONCLUSION

Deep convolutional neural networks identified most PTXs with a sensitivity of 94%, and were perfectly accurate (100%) in identifying normal radiographs as not having a large PTX. However, specificity was reduced in differentiating PTX from potential mimics such as those with bullous disease, as well as resolved PTXs with chest tubes and support lines. More training data and other deep learning architectures may improve these results.

CLINICAL RELEVANCE/APPLICATION

Automated detection of large pneumothoraces using deep convolutional neural networks may reduce time to identification and reporting of such critical results.


103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA13

Science Session with Keynote: Molecular Imaging (Neuroinflammation, Brain Injury and Glioma)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S504CD

ER MR MI NR

AMA PRA Category 1 Credits \mathbb{M} : 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

Alexander Drzezga, MD, Cologne, Germany (*Moderator*) Consultant, Siemens AG; Consultant, Bayer AG; Consultant, General Electric Company; Consultant, Eli Lilly and Company; Consultant, The Piramal Group; Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG; Speakers Bureau, General Electric Company; Speakers Bureau, Eli Lilly and Company; Speakers Bureau, The Piramal Group

Sub-Events

SSA13-01 Molecular Imaging Keynote Speaker: Imaging of Neuroinflammation

Sunday, Nov. 26 10:45AM - 10:55AM Room: S504CD

Participants

Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Presenter*) Research Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd;

SSA13-02 Neuroinflammation in Acute Hepatic Encephalopathy Rats: Imaging and Therapeutic Effectiveness Evaluation Using 11C-PK11195 and 18F-DPA-714 Micro-Positron Emission Tomography

Sunday, Nov. 26 10:55AM - 11:05AM Room: S504CD

Participants

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PURPOSE

Neuroinflammation is important in hepatic encephalopathy (HE). 11C-PK11195 is most common positron emission tomography (PET) molecular probe of neuroinflammation targeted to translocator protein (TSPO). 18F-DPA-714, a new radiotracer of TSPO, has not been used in research of neuroinflamation in acute hepatic encephalopathy (AHE). The aim of this study was to compare two radiotracers, 11C-PK11195 and 18F-DPA-714, as neuroinflammation agents for imaging of AHE rat model and using the new radiotracer 18F-DPA-714 imaging to observe therapeutic effectiveness treatment to neuroinflammation in AHE.

METHOD AND MATERIALS

Firstly, comparative study of 11C-PK1195 and 18F-DPA-714 PET were performed to AHE rats induced by thioacetamide. Twentyfour rats were divided into control (n=12) and AHE group (n=12), two radiotracers PET imaging (n=6 for each) was performed in each group, respectively. Uptake values of the whole brain between two groups were compared. Then, the optimized tracer were used to monitor anti-neuroinflammation effects of AHE. Forty-six rats were divided into four groups: [normal saline (NS) group (n=13), minocycline (MINO) group (n=11), dexamethasone (DEXA) group (n=11), MINO+DEXA group (n=11)]. 18F-DPA-714 PET was performed and the uptake values were calculated. The rotarod test, biochemical indexes and histopathological examination were quantitatively measured and compared.

RESULTS

AHE rats showed reduced motor ability, higher ammonia levels and liver function indexes and unchanged inflammatory factors compared with control group. Both 11C-PK11195 and 18F-DPA-714 PET can detect neuroinflammation of AHE rats. Behavioral studies showed MINO or/and DEXA improved AHE rats' motor ability, however, no differences were found for liver function and inflammatory markers among four groups. The average uptake values of whole brain and multiple brain areas in the MINO+DEXA group were lower than other groups, which was demonstrated by CD11b stains of microglia.

CONCLUSION

Both 11C-PK11195 and 18F-DPA-714 PET can detect neuroinflammation of AHE models, while the combined use of minocycline and dexamethasone can effectively inhibit neuroinflammation of AHE rats, which can be sensitively monitored by 18F-DPA-714 PET.

CLINICAL RELEVANCE/APPLICATION

Both 11C-PK11195 and 18F-DPA-714 PET might detect neuroinflammation of AHE models, and the treatment effect could be sensitively monitored by 18F-DPA-714 PET.

SSA13-03 Comparison Study of Radiogenomics Association and Prognostic Value Between MR Dynamic Susceptibility Contrast Perfusion Weighted Imaging and Diffusion Imaging in Patients with Newly Diagnosed Glioblastoma

Sunday, Nov. 26 11:05AM - 11:15AM Room: S504CD

Participants Xiang Liu, MD, Rochester, NY (*Presenter*) Nothing to Disclose Wei Tian, MD, PhD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

MR DSC-PWI and DWI are advanced imaging techniques investigating glioblastoma hemodynamic and tumor cellularity abnormality in vivo. The purpose of this study is to evaluate and compare the association between genomic biomarkers and imaging parameters derived from MR DSC-PWI and DWI, and their prognostic value in predicting overall survival time (OS) in patients with newly diagnosed glioblastomas.

METHOD AND MATERIALS

Forty-one cases (mean age is 62.32±12.09) with new pathology confirmed glioblastomas were enrolled in this study. The mean, maximal relative cerebral blood volume (rCBV) ratio, mean apparent diffusion coefficient (ADC) and minimal ADC of the enhancing tumor (rCBVmean, rCBVmax, ADC mean and ADCmin), maximal rCBV ratio and minimal ADC of peri-enhancing tumor area (rCBVperitumor and ADCperi-tumor) were measured. The association between imaging parameters and Ki-67 labelling index, isocitrate dehydrogenase (IDH), mammalian target of rapamycin (mTOR), and EGFR was assessed, the Cox regression was used to evaluate their implication on OS.

RESULTS

There were 40 cases without IDH mutation, and there was no significant between ADC parameters and genomic biomarkers (p>0.05). In contrast, the rCBVmax had significant association with mTOR, (p=0.047), the rCBVperi-tumor was significantly associated with mTOR after adjustment of gender and EGFR. The Cox regression analysis showed that rCBVperi-tumor and age were the two strongest predictors of OS (hazard ratio= 1.29 and 1.063; p=0.003 and 0.005 respectively). The rCBVperi-tumor had better area under the curve than other imaging parameters and genomic biomarkers in ROC analysis, combination of rCBVperi-tumor and age improved the predication of OS with specificity of 78.9% and sensitivity of 81.8%.

CONCLUSION

This comparison study showed significant radiogenomics association between quantitative rCBV parameters and mTOR-EGFR pathway biomarkers, and rCBVperi-tumor had better prognostic value than genomic biomarkers and ADC parameters, which may suggest the tumor angiogenesis is moderated by mTOR-EGFR pathway plays more important role in tumor progression in patients with primary glioblastoma, and the genomics mechanism related with tumor cellularity changes may be more complicated.

CLINICAL RELEVANCE/APPLICATION

This study showed that rCBVperi-tumor had better prognostic value than genomic biomarkers alone, these radiogenomics findings will be useful in developing new target therapy.

SSA13-04 Roles of Elevated 20-HETE in the Breakdown of Blood Brain Barrier and the Severity of Brain Edema in Experimental Traumatic Brain Injury

Sunday, Nov. 26 11:15AM - 11:25AM Room: S504CD

Participants

Liyan Lu, Nanjing, Christmas Island (Presenter) Nothing to Disclose

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PURPOSE

Breakdown of the blood brain barrier (BBB) is a secondary injury following traumatic brain injury (TBI) and can lead to the development of brain edema. However, the factors that contribute to the disruption of the BBB and increase the severity of brain edema in TBI remain to be elucidated. The inhibition of 20-hydroxyeicosatetraenoic acid (20-HETE) synthesis by HET0016 has been suggested as a strategy to decrease brain edema. The present study aimed to investigate whether the elevated production of 20-HETE in cerebral tissue may contribute to BBB breakdown and increase the severity of brain edema in rats with TBI.

METHOD AND MATERIALS

BBB permeability was quantified using dynamic contrast-enhanced magnetic resonance imaging and brain edema was measured according to brain water content. Superoxide production in injured tissue was also assessed. Liquid chromatography-mass spectrometry was used to evaluate 20-HETE production in injured tissue. Western blot analysis was used to assess the expression of occludin, zonula occludens (ZO)-1, matrix metalloproteinase (MMP)-9, and proteins of the c-Jun N-terminal kinase (JNK) pathway.

RESULTS

A total of 3, 24 and 72 h following the induction of TBI, 20-HETE levels, BBB permeability and brain edema were identified to be increased, accompanied by an increase in superoxide production. Conversely, superoxide dismutase levels, in addition to the total antioxidative capability were decreased. In addition, the expression of MMP-9 and proteins of the JNK pathway was upregulated, whereas the expression of occludin and ZO-1 was observed to be suppressed. These results suggested that 20-HETE may aggravate BBB disruption following TBI, via enhancing the expression of MMP-9 and tight junction proteins. Furthermore, oxidative

stress and the JNK signaling pathway may be involved in BBB dysregulation.

CONCLUSION

In conclusion, the results of the present demonstrated that the production of 20-HETE was increased in cerebral tissue following traumatic injury, thus suggesting that it may contribute to the compromise of BBB integrity and the development of brain edema.

CLINICAL RELEVANCE/APPLICATION

This study was to explore the mechanism for the compromise of blood brain barrier integrity and the development of brain edema following traumatic brain injury. Furthermore, clinically, we could find another reason and tool to solve the problem of disruption of blood brain barrier afer traumatic brain injury.

SSA13-05 Multimodal PET and MR Imaging With Pathologic Confirmation Detects Axonal and Synaptic Preservation After Paclitaxel Administration for Repeat Concussive Brain Injury in Mice

Sunday, Nov. 26 11:25AM - 11:35AM Room: S504CD

Participants

Chloe G. Cross, BSC, Salt Lake City, UT (*Presenter*) Nothing to Disclose James Meabon, PhD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Marcella Cline, BS, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Todd L. Richards, PhD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Megan Ostlie, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose David Cook, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Donna J. Cross, PhD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd;

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PURPOSE

PET and MR imaging have been proposed as biomarkers to evaluate repeat concussive brain injury (rcTBI) clinically. In this study, we hypothesized that imaging could be used in mice to detect axonal and synaptic injury from rcTBI as well as response to therapeutic intervention by paclitaxel.

METHOD AND MATERIALS

Mice received repeat concussive controlled cortical impact (rcCCI) one impact/day for five days (n=15) or sham CCI (n=8). Intranasal PTX (0.6 mg/kg; n=6) or saline (SAL) (n=9) was administered only after first CCI. Diffusion tensor imaging (DTI) was acquired on 14T as a 4 shot EPI, TR/TE=500/16.482ms, 30 diff directions, Max bval=6477.26849710899 s/mm2. Fractional anisotropy (FA) was compared using manual ROIs as well as FSL tract-based spatial statistics (TBSS). Glucose metabolism was assed via SUV corrected 18F-flurodeoxyglucose (FDG) PET imaging as a biomarker for synaptic activity. At 45 days, brains were evaluated for pathologic evidence of axonal injury (silver stain) and synaptic loss (PSD-95) in the external capsule and hippocampus respectively.

RESULTS

FA in the external capsule was decreased in rcTBI by 17% compared to SHAM (0.21 ± 0.01 vs 0.25 ± 0.01 , p<=0.05) and extensive areas of white matter injury were seen by TBSS. However, PTX-rcCCI was not significantly different from SHAM or SAL-rcCCI with either analysis. With silver stain, axonal degeneration was seen in cortical white matter of the external capsule in 5/6 SAL-rcCCI but not PTX-treated (n=0/5). A single, dystrophic axon was observed in 1/8 shams. The SAL-rcCCI showed significantly decreased brain FDG uptake, which was "normalized" in PTX mice. Whole brain SUVs, were 120.5 \pm 30.1, 90.3 \pm 18.7 and 129.2 \pm 23.0, for SHAM, SAL- and PTX-rcCCI respectively, p<=0.05. In SAL-rcCCI, hippocampal PSD-95 immunofluorescence was reduced compared to both SHAM and PTX.

CONCLUSION

Both DTI and FDG-PET detected brain alterations in white matter structure and glucose metabolism from repeat concussive injury. However, only FDG-PET confirmed that PTX resulted in improvement when pathology indicated both synaptic loss AND axonal injury were prevented with PTX. DTI may not be sensitive enough or may have more inherent variability to detect treatment-related benefit in rcTBI. Further research is needed to distinguish these factors.

CLINICAL RELEVANCE/APPLICATION

Establishment of brain imaging biomarkers is of critical importance to research and therapeutic development for traumatic brain injury.

SSA13-07 Evolution of Diffusion in Hematoma and Perihematoma after Experimental Intracerebral Hemorrhage by 7.0 T DTI

Sunday, Nov. 26 11:45AM - 11:55AM Room: S504CD

Awards

Student Travel Stipend Award

Participants Chunhua Wang, MD, Chengdu, China (*Presenter*) Nothing to Disclose Li Song, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose Ruzhi Zhang, BSC, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose Fabao Gao, MD, PhD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose To characterize experimental hematoma and perihematoma using diffusion tensor imaging (DTI) and compare the feature of diffusion with that of histology after intracerebral hemorrhage (ICH).

METHOD AND MATERIALS

Twenty-nine male SD rats injected with 40 μ L autologous blood in the right basal ganglia underwent 7.0 T MR with T2WI (additional day 0, D0) and DTI sequences at days 1 (D1), 3 (D3), 7 (D7), 14 (D14), 21 (D21), and 28 (D28). HE, Iba1, and glial fibrillary acidic protein staining was performed after brain fixation. Hematoma volume at D0 was measured by T2WI images. Mean diffusivity (MD), axial diffusivity, and radial diffusivity were measured by DTI images. Abnormal MD volumes were delineated manually by MD maps.

RESULTS

The mean hematoma volume was 14.78 μ L at D0. The main patterns of diffusivity changes in the ipsilateral basal ganglia after ICH on MD maps visually included relative central hyper-value zone (rCEVZ; MD at D1: 9.54 ± 2.57 x 10-4mm2/s), relative hypo-value zone (rOVZ; MD at D1: 6.94 ± 0.96 x 10-4mm2/s), and relative peripheral hyper-value zone (rPEVZ; MD at D1: 9.61 ± 0.59 x 10-4mm2/s). The rCEVZ corresponded to the area with not only heterogeneous erythrocytes and serum at D1, D3, and D7, but also necrosis of brain parenchyma at D1 and D3. The rOVZ corresponded to the area with vasogenic and cytotoxic edema at D1, D3 and D7, neutrophil accumulation at D3 and D7, microglia proliferation from D3 to D28, and astrocyte proliferation from D7 to D28. The rPEVZ corresponded mainly to the area with cytotoxic and vasogenic edema at D1, D3 and D7, also with glial cell proliferation from D3 to D28. Volumes of abnormal diffusion at D1 and D3 were significantly greater than the hematoma volume at D0 (both p < 0.001). The rCEVZ volumes at D1, D3, and D7 were significantly lower than hematoma volume at D0 (all p < 0.001). The rOVZ and rPEVZ volumes peaked at D1 and D3, respectively.

CONCLUSION

The results imply diffusion changes in hematoma and perihematoma after ICH involve complex pathological alterations including blood components, cytotoxic and vasogenic edema, and cellular accumulation and proliferation.

CLINICAL RELEVANCE/APPLICATION

This research exhibit evolution of diffusion in hematoma and perihematoma with histological basis, which is useful to explain the diffusion changes in patients after intracerebral hemorrhage.

SSA13-08 Amide Proton Transfer-Weighted MRI Signal As a Novel Imaging Marker for Prediction of MGMT Promoter Methylation Status in Glioblastoma

Sunday, Nov. 26 11:55AM - 12:05PM Room: S504CD

Participants

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PURPOSE

Methylated O6-methylguanine-DNA methyltransferase (MGMT) promoter fosters longer survival in patients with Glioblastoma (GBM) who receive alkylating agents due to the reduced counteraction of alkylating chemotherapy. However, the MGMT methylation status test primarily relies on the invasive surgical procedure. Amide proton transfer-weighted (APTW) imaging is a novel molecular MRI technique that gives contrast mainly based on endogenous cellular proteins. This study aimed to investigate whether MGMT methylation status in GBM is correlated to APTW imaging features.

METHOD AND MATERIALS

Patients with suspected GBM underwent routine and APTW MR sequences at 3T prior to surgery. The MGMT methylation status was assessed with immunohistochemical stain and verified by methylation-specific polymerase chain reaction. APTW images were calculated using MTRasym(3.5ppm). The maximum and minimum (APTWmax and APTWmin), the average (APTWave), and the heterogeneity (APTWhet = APTWmax - APTWmin) of APTW signal intensities were obtained using the contralateral normal brain area as normalization.

RESULTS

Eleven patients with GBM were confirmed as MGMT promoter methylated, and the remaining seven patients were confirmed as unmethylated. Most GBMs with unmethylated MGMT demonstrated heterogeneous, strong hyperintensity on APTW images (A), while most GBMs with methylated MGMT showed heterogeneous, moderate APTW hyperintensity (B). The unmethylated MGMT group has significantly higher APTWmax ($3.46 \pm 0.49\%$ vs. $2.67 \pm 0.59\%$); APTWave ($2.90 \pm 0.37\%$ vs. $2.28 \pm 0.47\%$); APTWmin ($2.31 \pm 0.27\%$ vs. $1.90 \pm 0.42\%$); and APTWhet ($1.15 \pm 0.33\%$ vs. $0.77 \pm 0.23\%$) than the methylated MGMT group, all p < 0.05 (C). APTWmax and APTWave had the highest area under the curve (0.857) and accuracy (90.4%) in differentiating GBMs with methylated MGMT GBMs (D).

CONCLUSION

Our early results suggest that GBMs with different MGMT methylation statuses are associated with distinguishable APTW imaging

features. The APTW signal is a valuable imaging biomarker for identifying MGMT methylation status of GBMs, which is of paramount importance for the management of alkylating agent chemotherapy.

CLINICAL RELEVANCE/APPLICATION

Preoperative APTW imaging signal has the potential to non-invasively predict the MGMT promoter methylation status in patients with GBM. APTW signal may serve as a surrogate imaging maker for identifying the MGMT promoter methylation status preoperatively.

SSA13-09 Lipopolysaccharide Endotoxemia Results in Secondary Neuroinflammation and Deposition of Amyloid Beta and Phosphorylated Tau in the Rat

Sunday, Nov. 26 12:05PM - 12:15PM Room: S504CD

Participants

Ahmed H. Ebada Salem, MBBCh,MSc, Alexandria, Egypt (*Presenter*) Nothing to Disclose Rosana S. Rodrigues, MD, PhD, Gavea, Brazil (*Abstract Co-Author*) Nothing to Disclose John M. Hoffman, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Rheal A. Towner, PhD, Oklahoma City, OK (*Abstract Co-Author*) Nothing to Disclose Jeffrey T. Yap, PhD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Kathryn A. Morton, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Amyloid-Beta (AB) plaque deposition occurs in Alzheimer's disease as well as aging and other neurodegenerative disorders. Soluble AB may increase in response to neuroinflammation. Sepsis results in short and long term neurocognitive impairment in many patients. The objective was to determine whether acute systemic endotoxemia results in secondary neuroinflammation with consequent AB plaque and p-tau deposition in the brain.

METHOD AND MATERIALS

Male Sprague Dawley rats received an IP injection of 10 mg/kg of E. Coli lipopolysaccharide (LPS) to mimic sepsis. IL-1B, IL-6 and TNFA were measured by ELISA in whole brain homogenates of LPS-injected and control rats. Soluble AB and p-tau proteins in brain homogenates were measured by immunoblotting. Cortical AB plaques were quantified by immunostaining and morphologically characterized by confocal microscopy. Microglial density was quantified by Iba1 immunostaining. At 72 h post LPS administration, rats were injected intravenously with 18F-flutemetamol and the resultant brain uptake was quantified by digital autoradiography of cryomicrotome slices.

RESULTS

Endotoxemia resulted in increased cytokines in the brain, particularly IL-1B (7.8 fold increase over controls at 24h, p < .0001). Cortical microglial density was 1.9-fold higher LPS-injected rats than controls (p < .001). Compared to controls, systemic LPS produced significant brain increases of soluble AB (1.98-fold increase, p < .01) and p-tau (2-fold increase, p < .01) and a progressive accumulation of AB aggregates, which were morphologically similar to diffuse plaques. There was no significant difference in uptake of 18F-flutemetamol in the cerebral white matter (corpus callosum) in the brains of LPS-treated vs. control rats. The cerebral cortical activity was 2.02 fold higher in LPS than control rats (p < .01), a difference that was visually appreciable.

CONCLUSION

LPS endotoxemia causes secondary neuroinflammation and elevations in cytokines, soluble AB, p-tau and AB plaques in the brain, and cortical deposition of 18F-flutametamol. Whether these findings eventually resolve or are associated with neurocognitive impairment are as of yet unknown.

CLINICAL RELEVANCE/APPLICATION

18F flutemetamol PET could provide a mechanism to study the effects of systemic inflammatory conditions on the brain, the pathogenesis of which may involve the accumulation of AB.





103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA14

Science Session with Keynote: Musculoskeletal (Lower Extremity)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S406A



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

Participants

Corrie M. Yablon, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose Karen C. Chen, MD, Providence, RI (*Moderator*) Nothing to Disclose

Sub-Events

SSA14-01 Musculoskeletal Keynote Speaker: Update on Lower Extremity Imaging

Sunday, Nov. 26 10:45AM - 10:55AM Room: S406A

Participants

Laura W. Bancroft, MD, Orlando, FL (Presenter) Author with royalties, Wolters Kluwer nv

SSA14-02 CT Texture Analysis of Acetabular Subchondral Bone Can Discriminate Between Normal and Cam Positive Hips in Femoroacetubular Impingement

Sunday, Nov. 26 10:55AM - 11:05AM Room: S406A

Participants

Taryn Hodgdon, MD, Ottawa, ON (*Presenter*) Nothing to Disclose Rebecca Thornhill, PhD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose Paul E. Beaule, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose Kawan S. Rakhra, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Cam-type femoroacetabular impingement (FAI) has been associated with early degenerative change of the hip. The purpose of this study was to assess whether texture analysis could determine microscopic changes in the architecture of acetabular subchondral bone prior to the development of macroscopic structural damage on CT.

METHOD AND MATERIALS

This was an IRB-approved, retrospective case-control study analyzing CT images obtained in subjects with and without cam-type deformities of the proximal femur. Subjects with cam deformity were further subdivided into asymptomatic cam and symptomatic cam-FAI groups. There were a total of 68 patients: 19 controls, 26 asymptomatic cam, and 23 symptomatic cam-FAI. All subjects underwent CT scan of the pelvis. The subchondral bone of the entire acetabulum was contoured manually as a volume of interest (VOI) on the sagittal images for each patient using ImageJ (8). 3D histogram texture features (mean, variance, skewness and kurtosis) were evaluated for each patient using MaZda software. Groupwise differences (controls, asymptomatic cam, and symptomatic cam patients) were initially investigated for each feature using Kruskal-Wallis tests. Subsequently, differences between controls and either asymptomatic or symptomatic cam deformities were assessed using Mann-Whitney U tests with posthoc Bonferroni correction for multiple comparisons.

RESULTS

Both asymptomatic and symptomatic cam-FAI hips demonstrated significantly higher values of texture variance compared to normal controls (p=0.002, p=0.003), but significantly lower values of skewness (p=0.005, p=0.002) and kurtosis (p=0.003, p=0.004) compared to normal controls. There were no differences in texture profile between asymptomatic cam and symptomatic cam-FAI hips.

CONCLUSION

Hips with cam deformities demonstrated increased variance, decreased skewness, and decreased kurtosis compared to normal control subjects. These findings suggest that 3D histogram texture features extracted from CT images can detect differences in subchondral bone architecture between controls and those with cam deformities, regardless of the patient's symptom status.

CLINICAL RELEVANCE/APPLICATION

Changes in texture profile of asymptomatic cam hips is as pronounced as that of symptomatic cam-FAI hips. This may facilitate identification of patients at risk of developing hip dysfunction due to altered biomechanics conferred by the bone changes.

SSA14-03 Variability of MRI Reporting in Proximal Hamstring Avulsion Injury

Sunday, Nov. 26 11:05AM - 11:15AM Room: S406A

Michael Alaia, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Kirk Campbell, New York, NY (*Abstract Co-Author*) Nothing to Disclose Gina A. Ciavarra, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Elisabeth R. Garwood, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Michael P. Recht, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Quantification of tendon retraction is paramount in management of proximal hamstring avulsions, impacting the decision to perform surgery and the type of incision used. However, variability in the measurement landmark used on the broad ischial tuberosity origin, and difficulty in locating the proximal tendon stump may lead to significant variability in measured retraction. The purpose of our study was to survey musculoskeletal (MSK) radiologists and orthopedic surgeons on the ischial tuberosity landmark used in hamstring avulsion, and the clinical impact of MRI measurements and report content.

METHOD AND MATERIALS

Two survey instruments were created. One survey was sent by email to members of the Society of Skeletal Radiology (SSR), querying the preferred ischial tuberosity landmark, perceived difficulties in quantifying retraction, and the impact of the radiology report on clinical decision making. A similar survey, with added questions on the impact of imaging findings, was posted onto the American Orthopaedic Society for Sports Medicine (AOSSM) website and sent by email to orthopedic colleagues.

RESULTS

A total of 218 MSK radiologists (SSR members), and 33 orthopedic surgeons completed the survey. The conjoint tendon origin was the most common proximal landmark used for both orthopedic surgeons (66.7%) and radiologists (47%) in complete hamstring avulsion. For 71% of orthopedic surgeons, the radiology report impacts the decision to perform surgery, and for 45%, the report impacts the incision used. 36% of orthopedic surgeons report overestimation of measurements in radiology reports due to differences in landmarks used for measurement, while 27% report underestimation. 43% of radiologists report difficulty in determining location of the retracted tendon, and 31% report difficulty determining the ischial tuberosity landmark for measurement.

CONCLUSION

Differences in the ischial tuberosity landmark used, and difficulty in locating the proximal tendon stump may lead to variability in measured tendon retraction in proximal hamstring avulsion, and may alter the decision to perform study and the type of incision used.

CLINICAL RELEVANCE/APPLICATION

Differences in the ischial tuberosity landmark used, and difficulty in locating the proximal tendon stump may lead to variability in measured tendon retraction in cases of proximal hamstring avulsion, and may significantly impact surgical management.

SSA14-04 Does Labral Size and Tear Pattern Differ Between FAI Patients with Femoral Retrotorsion Compare to Increased Femoral Antetorsion?

Sunday, Nov. 26 11:15AM - 11:25AM Room: S406A

Participants

Inga Todorski, Bern, Switzerland (*Presenter*) Nothing to Disclose Florian Schmaranzer, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose Till Lerch, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose Simon D. Steppacher, MD, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose Klaus A. Siebenrock, MD, PhD, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose Moritz Tannast, MD, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

In patients with femoroacetabular impingment (FAI) femoral retrotorsion and increased femoral antetorsion (FT) contribute to an unknown degree to the bony conflict. Hence the role of de-/rotational osteotomies is yet to be defined in FAI patients. In hip dysplasia, cam and pincer FAI the labrum shows distinct tear patterns. By contrast, the impact of femoral retrotorsion and increased FT on labral tear patterns and labral size is currently unclear. Our aim was to compare (1) labral size and (2) tear pattern between hips with femoral retrotorsion and increased FT.

METHOD AND MATERIALS

After IRB approval for this retrospective study the institutional MR database (2011-2016; 620 hips) was reviewed for direct MR arthrographies (3.0T) in FAI hips with femoral retrotorsion (30° FT, 71 hips). Groups were comparable for age, acetabular version and coverage (LCE between 22° and 39°). Additionally to the multiplanar standard protocol, axial images including the distal femoral condyles for measurement of FT and 2D radial PD-w images using the femoral neck axis as center of rotation were obtained. On each half o'clock position (30° intervals per slide gap) the labral cross sectional area (CSA, mmSquared) was measured circumferentially with OSIRIX® software. Labrum tear pattern was described as follows: intact, degeneration, intersubstance tear, intrasubstance tear. CSA was compared with unpaired t-tests and labrum tear pattern was compared with chi-square test between the groups (p<0.05).

RESULTS

(1) Labral CSA was significantly decreased from 7.30 to 4.30 o'clock in hips with femoral retrotorsion compared to hips with increased FT (p<0.05).(2) Prevalence of intrasubstance tears was significantly higher anteriorly (1.30 to 3 o'clock position; p<0.05) in hips with increased FT compared to hips with femoral retrotorsion.

CONCLUSION

Labral size and tear pattern differ between FAI patients with femoral retrotorsion compared to increased FT. A hypotrophic labrum in hips with femoral retrotorsion may reflect an anterior impingement. Higher prevalence of anterior intrasubstance labrum tears

could result from instability in hips with increased FT.

CLINICAL RELEVANCE/APPLICATION

Systematic assessment of labrum size and tear pattern in patients with FAI can help to define the role of additional femoral de-/rotational osteotomies in FAI patients.

SSA14-05 Comparison of a Fast 5-minute Knee MRI Protocol with a Standard Knee MRI Protocol: A Multiinstitutional Multireader Study

Sunday, Nov. 26 11:25AM - 11:35AM Room: S406A

Participants

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PURPOSE

The purpose of this study was to compare the diagnostic performance of a 5-minute knee MRI protocol with parallel imaging to that of a standard knee MRI protocol.

METHOD AND MATERIALS

100 3T MRIs of 100 patients (mean age, 38.8 years) and 50 1.5T MRIs of 46 patients (mean age, 46.4 years), consisting of 5 fast multiplanar 2D FSE sequences using parallel imaging and 5 standard sequences, performed at 2 academic centers from January 2015 to July 2016 were retrospectively reviewed by 4 MSK radiologists. Agreement between fast and standard MRI readings (interprotocol agreement) and agreement of standard MRI readings (intraprotocol agreement) when evaluating menisci, ligaments, cartilage and bone was compared for interchangeability. Additional comparisons between fast and standard MRI with regards to frequency of major findings and sensitivity and specificity in 51 patients who underwent surgery were tested for significant differences.

RESULTS

Interreader agreement with fast MRI was very similar to interreader agreement with standard MRI (83.0-99.5% across structures) with no excess disagreement (<=1.1%; 95% CI, -4.2% to 3.8% across structures). Frequency of major findings (1.1-22.4% across structures) reported on fast and standard MRI were not significantly different (p >= 0.215 across structures) except more ACL tears were reported on fast MRI (p=0.021) and more cartilage defects were reported on standard MRI (p<0.001). Sensitivities (59-100% across structures) and specificities (73-99% across structures) of fast and standard MRI were not significantly different for meniscal and ligament tears (95% CI for difference, -0.08 to 0.08). For cartilage defects, fast MRI was slightly less sensitive (95% CI for difference, -0.125 to -0.01) but slightly more specific (95% CI for difference, 0.01 to 0.5) than standard MRI.

CONCLUSION

A fast 5-minute knee MRI using parallel imaging is interchangeable with and has similar accuracy to a standard knee MRI for evaluating internal derangement of the knee.

CLINICAL RELEVANCE/APPLICATION

A fast 5-minute knee MRI would be helpful to improve efficiency and patient throughput when MRI availability is limited and increase patient comfort and exam tolerability in patients with claustrophobia and pain.

SSA14-06 Does Cartilage Repair Surgery Prevent Progression of Knee Degeneration? A Quantitative Controlmatched MRI Study

Sunday, Nov. 26 11:35AM - 11:45AM Room: S406A

Participants

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PURPOSE

To assess, whether cartilage repair surgery (CR) for treatment of focal cartilage defects at the knee prevents progression of degenerative changes on MRI in a longitudinal follow-up.

METHOD AND MATERIALS

A total of N=32 individuals with focal cartilage defects at the knee received baseline and 6-year follow-up MRI studies. Preoperative MRIs of n=16 individuals (12 male, 4 female) who received CR surgery were matched with n=16 baseline MRIs of individuals from the

Osteoarthritis Initiative (OAI) with initially morphologically identical cartilage defects (control group without surgery; 6 male, 6 female). Morphological knee abnormalities were assessed using Whole-Organ-Magnetic-Resonance-Imaging-Scores (WORMS), AMADEUS scores and MOCART scores. Mean values, mean differences and standard deviations (SD), paired t-tests and multiple regression models were used for statistical analyses.

RESULTS

In both groups, focal cartilage defects were found at the femoral condyle in 8/16 cases and at the patella in 8/16 cases. Total WORMS scores (mean difference \pm SD, -4.7 \pm 10.2, P=0.085) and cartilage scores for the affected knee compartment (-0.3 \pm 1.5, P=0.378) were not significantly different between the two groups at baseline. The increase of total WORMS scores during identical follow-up times (CR patients: 5.7 \pm 2.3 years; OAI: 5.6 \pm 1.4 years) was significantly more severe in individuals that did not receive surgery (P<0.001). Cartilage defects at the affected (P<0.001) and opposing compartment (P=0.029) showed a more severe progression in the non-operated cohort (Figure 1). For patients that received CR, the mean preoperative AMADEUS score was 48.1 \pm 15.8 and the mean postoperative MOCART score was 77.5 \pm 18.9. In control subjects from the OAI, cartilage T2 relaxation times increased from 32.4 \pm 2.5ms at baseline to 34.5 \pm 2.3ms at follow-up (P=0.002).

CONCLUSION

Since patients with CR showed significantly less progression of cartilage defects and of degenerative MRI changes at the knee (WORMS scores) than an initially identical control cohort from the OAI in a 6 year follow-up, CR may prevent progression of early osteoarthritis.

CLINICAL RELEVANCE/APPLICATION

This MR imaging pair-matched study supports the assumption, that osteochondral transplantation prevents progression of cartilage defects and early osteoarthritis at the knee in a mid-term follow-up.

SSA14-07 Weight-Bearing Digital Tomosynthesis of Foot/Ankle Arthritis: Comparison to Radiography and Simulated Weight-Bearing Computed Tomography

Sunday, Nov. 26 11:45AM - 11:55AM Room: S406A

Participants

Alice S. Ha, MD, Seattle, WA (*Presenter*) Research Grant, General Electric Company Xue B. Cunningham, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Alan S. Leung, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Jennifer L. Favinger, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Daniel S. Hippe, MS, Seattle, WA (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company; Research Grant, Toshiba America Medical Systems

PURPOSE

Foot/ankle arthritis is common and debilitating. Weight-bearing radiography remains the gold standard in evaluating alignment, but overlapping bones or hardware limit evaluation for arthritic bony detail. We hypothesized that digital tomosynthesis (DTS) can provide reliable quantitative alignment values like radiography with its weight-bearing capability and good qualitative arthritic details like computed tomography (CT) with its plane-by-plane images.

METHOD AND MATERIALS

In this IRB-approved prospective study, adult patients with foot/ankle pain and arthritis referred for simulated weight-bearing CT were recruited to undergo weight-bearing radiography and DTS. Four readers independently evaluated radiography and DTS images in randomized orders for foot/ankle alignment and severity of osteoarthritis for each joint (e.g., joint space narrowing, osteophytes, subchondral cyst). Two readers performed consensus reading of CT. Radiography was considered the gold standard for foot alignment and CT for osteoarthritic details. Agreement between modalities was assessed using the intraclass correlation coefficient (ICC) (quantitative variables) and Cohen's kappa (qualitative variables).

RESULTS

46 patients (24 men; mean age 54 years) with a total of 91 ankles were included. Trauma (67%), osteoarthritis (52%), and congenital deformity (41%) were the most common prior conditions. All joints were less obscured when seen with DTS or CT (4-11%) when compared to radiography (14-34%, p<0.001). For quantitative measurements of foot alignment (Table 1), DTS had moderate to good agreement with radiography, which was significantly better than CT in most cases. For qualitative osteoarthritic details of the tibiotalar joint (when not obscured), agreement was moderate to good for most features, with kappa ranging from 0.47 to 0.62 between radiography and CT and from 0.48 and 0.63 between DTS and CT.

CONCLUSION

DTS leads to less obscuration of joints than radiography and provides reliable weight-bearing quantitative foot/ankle alignment values when compared to radiography and osteoarthritic bony details when compared to CT.

CLINICAL RELEVANCE/APPLICATION

Digital tomosynthesis allows for tomographic characterization of foot/ankle arthritis while weight-bearing with comparable details to CT with less cost and radiation.

SSA14-08 Intravoxel Incoherent Motion (IVIM) Imaging of Exercised Induced Hemodynamics Response in Achilles Tendon

Sunday, Nov. 26 11:55AM - 12:05PM Room: S406A

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PURPOSE

Achilles tendon (AT) microcirculation plays a crucial role in tendon degeneration and repair. Intravoxel incoherent motion (IVIM) MRI has been applied in skeletal muscle hemodynamics by exercise. However, the application of IVIM to tendons is challenged by the short T2/T2* (~7 ms) and long TE (~50-80 ms) typically required. In this study, we utilized a stimulated-echo based short TE (<20 ms) tendon diffusion protocol (ste-RESOLVE) to study hemodynamic response in the Achilles tendon following exercise in healthy subjects, to provide a springboard to aid in our understanding of the role of hypovascularity in tendinopathy.

METHOD AND MATERIALS

Seven healthy subjects were recruited for this IRB approved study. After baseline tendon IVIM imaging at magic angle, subjects were instructed to perform 5 minutes of standardized heel-raise exercises outside the scanner immediately prior to re-imaging. The tendon diffusion coefficient (D), pseudo-diffusion coefficient (D*), and perfusion fraction (fp) were calculated using standard bi-exponential fit. $D^* \times fp$ was used as an indicator of blood flow, while fp was used as an indicator of blood volume.

RESULTS

The pre-exercise measured fp and D*x fp were $2.81\pm1.09\%$ and 17.45 ± 10.81 respectively. The post-exercise measured fp and D*x fp were $4.96\pm1.23\%$ and 40.52 ± 23.27 respectively. The relative increase in tendon blood volume and tendon perfusion was 87.11% and 227.41%, respectively.

CONCLUSION

This study evaluated the feasibility and robustness of a ste-RESOLVE-based IVIM protocol. We expect that our estimated IVM parameters in control subjects may serve as a baseline for subsequent studies on patients with clinical and subclinical Achilles tendinosis. We hope that this technique can now be used to monitor tendon healing and repair and assess the potential risk of rupture in diseased tendons.

CLINICAL RELEVANCE/APPLICATION

This study established the feasibility of using ste-RESOLVE IVIM protocol to measure exercise induced hemodynamics changes in Achilles tendon.

SSA14-09 Ankle Syndesmosis Measurements Using Four-Dimensional Computed Tomography: Correlation with Symptoms and Imaging Signs of Tibiotalar Osteoarthritis

Sunday, Nov. 26 12:05PM - 12:15PM Room: S406A

Awards

Student Travel Stipend Award

Participants

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Inc Stockholder, Tornier, Inc Stockholder, Royer Medical, Inc Stockholder, Bioactive Surgical, Inc Stockholder, HealthpointCapital Research support, Royer Medical, Inc Research support, Zimmer Biomet Holdings, IncResearch support, Tornier, Inc Research support, Arthrex, Inc Research support, SpineSmith LP Research support, BioMimetic Therapeutics, Inc Support, Bioactive Surgical, Inc Support, Educational Concepts in Medicine, LLC Support, Smith & Nephew plc Support, OrthoHelix Surgical Designs, Inc Support, Chesapeake Surgical Biocomposites Support, Olympus Corporation Support, Omega Surgical Instruments Ltd Shadpour Demehri, MD, Baltimore, MD (*Abstract Co-Author*) Research support, General Electric Company; Research Grant,

Carestream Health, Inc; Consultant, Toshiba Corporation;

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PURPOSE

Four-Dimensional CT (4DCT) can be used for the kinematic assessment of peripheral joints during active motion. Nevertheless, evidence regarding the use of 4DCT for the assessment of ankle pain and instability is limited. Our objective was to evaluate the correlation between CT-derived indices of ankle syndesmosis during active plantar-dorsiflexion motion and patient reported symptoms as well as imaging features of tibiotalar osteoarthritis (OA).

METHOD AND MATERIALS

This is an IRB approved HIPAA complaint, retrospective analysis of a group of prospectively recruited patients in our 4DCT study. Eight patients with chronic, unilateral signs and symptoms of ankle pain and instability referred for advanced imaging evaluation, were included in this study. Bilateral 4DCT was performed using a 320-row detector CT scanner (Aquilion one, Toshiba Medical Systems) during active motion from complete dorsiflexion to plantar flexion (0.5 sec. temporal resolution). Two previously defined indices of ankle syndesmosis were measured by a fellowship trained foot & ankle surgeon: 1.Syndesmotic Anterior Distance (SAD), 2.Syndesmotic Translation (ST). Tibiotalar OA was assessed using Kellgren-Lawrence (KL) grading. Reliability of the selected indices was confirmed in our previous study. Imaging examinations were interpreted by a musculoskeletal radiologist with 8 years of

RESULTS

There was a significant difference in the overall SAD measurements between asymptomatic (median centimeters (interquartile range): 0.37 (0.33 - 0.47)) and symptomatic (0.30 (0.26 - 0.38)) ankles. Unlike ST measurements (change in motion: -0.03 (-0.13 - 0.00) P:0.027), SAD measurements were not a function of ankle motion and tibiocalcaneal angle. Changes in SAD measurements from dorsiflexion to plantar flexion were significantly correlated with the tibiotalar OA severity, defined by KL grades (point biserial correlation coefficient: -0.688, P:0.003)

CONCLUSION

SAD does not change significantly during ankle dorsi/plantar flexion and is associated with the presence of symptoms and imaging features of osteoarthritis.

CLINICAL RELEVANCE/APPLICATION

Our study represents one of the very few kinematic assessments of ankle syndesmosis using 4DCT examination. Changes in SAD, but not ST measurements are independent of tibiocalcaneal angle. Increased changes in SAD during dorsiflexion and plantar flexion motion are correlated with clinical and imaging features of tibiotalar OA.







SSA15

Musculoskeletal (Bone Marrow and Neoplasms)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S406B



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

Participants

Jeffrey J. Peterson, MD, Neptune Beach, FL (Moderator) Nothing to Disclose Matthew D. Bucknor, MD, San Francisco, CA (Moderator) Nothing to Disclose

Sub-Events

SSA15-01 Comparison of Qualitative and Quantitative CT and MRI Parameters for Monitoring of Longitudinal Spine Involvement in Patients with Multiple Myeloma

Sunday, Nov. 26 10:45AM - 10:55AM Room: S406B

Participants

Christopher Kloth, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose Wolfgang M. Thaiss, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose Hendrik Ditt, Forchheim, Germany (Abstract Co-Author) Employee, Siemens AG Sebastian Werner, Tuebingen, Germany (Presenter) Nothing to Disclose Katja Weisel, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose Jan Fritz, MD, Baltimore, MD (Abstract Co-Author) Research Grant, Siemens AG; Scientific Advisor, Siemens AG; Scientific Advisor, Alexion Pharmaceuticals, Inc; Speaker, Siemens AG Konstantin Nikolaou, MD, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG Marius Horger, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose

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PURPOSE

To evaluate the diagnostic performance of CT-based quantification of skeletal changes using a dedicated post-processing subtraction tool by comparison with standard-CT reading and MRI for longitudinal disease monitoring in multiple myeloma.

METHOD AND MATERIALS

Included were 31 consecutive myeloma patients (17 male; mean age, $59.20 \pm 8.08y$) who underwent who underwent 154 repeated examinations consisting of whole-body MRI (n=76) and whole-body reduced-dose MDCT (n=78) at our institution between June 2013 and September 2016. Nonenhanced reduced-dose whole-body-CT was performed using thin-collimation. We classified response according to standard CT-reading into progression (new or enlarging osteolyses) vs. stable/ response (no change). Quantitative CT was performed on subtraction maps created for the entire axial skeleton. Results were classified into progressive disease (PD), stable (SD) and response (partial + complete, PR/CR). On MRI, bone marrow manifestations were evaluated by qualitative image analysis (number/size) on coronal T1w-TSE, T2*w and STIR. Standard-of-reference was the hematological laboratory (M-gradient).

RESULTS

Hematological response categories were: CR(n=14/47, 29.7%), PR(2/47, 4.2%), SD(16/47, 34.0%) vs. PD(15/47/29.9%). Standard-CT classification yielded PD (25.5%) and SD/PR/CR (74.5%) whereas quantitative CT classified 12 (25.5%) PD, 26 (55.3%) SD and 9 (19.2%) PR/CR. Qualitative MRI classified 14 (29.7%) PD, 16 (34%) SD and 17 (36.3%) PR/CR. Quantitative MRI measured in focal lesions yielded no significant change in T1/T2/T2* or ADC signal intensity between baseline and FU whereas at non-focally involved skeletal sites, signal intensity changes on T2w/T2* and ADC reached significance only in stable disease (p<0.001). Changes in mean/min/max HU values in bone on CT did not correlate significantly with changes in measured MRI values.

CONCLUSION

Imaging response monitoring using CT can be improved by using quantitative parameters for evaluation of focal lesions whereas for MRI only qualitative parameters prove reliable.

CLINICAL RELEVANCE/APPLICATION

The use of longitudinal bone subtraction maps for therapy response monitoring in MBD improves diagnostic accuracy by focusing the reader's attention solely on the bone changes that have occurred within the control interval, ignoring all other myriads of bone lesions staying unchanged.

SSA15-02 Quantification of Bone Marrow Adipose Tissue Using Off-the-shelf Gradient Echo MR Imaging

Sunday, Nov. 26 10:55AM - 11:05AM Room: S406B

Participants

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PURPOSE

To determine the feasibility of fast and widely available, Quantitative Gradient-Echo (QGRE) MRI for quantification of bone marrow adipose tissue (MAT) using, state of the art, SE-Dixon Quantitative Chemical Shift Imaging (QCSI) as a reference standard. Subsequently we aimed to determine age and gender specific differences in marrow fat fractions (FF) of the spine and femur.

METHOD AND MATERIALS

L3-5 FF of 11 patients with Gaucher disease (GD) were measured using both a QGRE sequence (scan time 1 minute) and our SE-Dixon QCSI sequence (scan time 21 minutes), on the same day, on a Siemens 1.5 Tesla MRI-scanner (Avanto). QGRE FF of the spine (C1-L5) and both femora were measured in 40 healthy subjects (median age: 51 years; range: 23-76; 26 males). Regions of interest covering the individual vertebral bodies were drawn on sagittal images. Coronal images of femora were acquired and divided into 3 regions of interest: proximal metaphysis, diaphysis and distal metaphysis. During post processing a multi peak fat model was used for fitting.

RESULTS

In GD, L3-5 QCSI and QGRE MRI, FF showed good agreement (intra class correlation coefficient L3-5: 0.80 (95% CI 0.32-0.95, p<0.001). In healthy subjects, QGRE spinal FF increased from cranial to caudal: mean FF(±SD): 36.1% (±9.9), 37.9% (±8.1) and 43.4% (±9.5) for the cervical, thoracic and lumbar spine respectively (linear mixed model: p<0.001). QGRE median femoral FF increased from proximal to distal: 83.8% (interquartile range: 76.6-88.0%), 89.7% (80.8-94.7%) and 95.0% (93.7-95.7%) for the proximal metaphysis, diaphysis and distal metaphysis respectively (Friedman test: p<0.001). In female subjects there was a strong correlation between age and femoral or spinal FF (p=0.73, p=0.01 and p=0.90 p<0.001 respectively), while in male subjects only spinal FF was correlated with age (spine: r=0.45, p=0.02, femur: r=0.04 p=0.84).

CONCLUSION

QGRE MRI is a fast, accurate and widely available, alternative for QCSI and allows quantification of MAT of the spine and femora with high spatial resolution. Gender and age specific differences in MAT should be taken in account when interpreting marrow FF.

CLINICAL RELEVANCE/APPLICATION

High vertebral MAT is associated with low bone mineral density and increased fracture risk. Accurate MAT quantification is necessary for the evaluation of MAT as a potential imaging biomarker.

SSA15-03 3T Chemical Shift Encoded MRI for Bone Marrow Adipose Tissue Composition Assessment

Sunday, Nov. 26 11:05AM - 11:15AM Room: S406B

Participants Dimitri Martel, PhD, New York City, NY (*Presenter*) Nothing to Disclose Benjamin Leporq, MS, Villeurbanne, France (*Abstract Co-Author*) Nothing to Disclose Mary Bruno, RT, New York, NY (*Abstract Co-Author*) Nothing to Disclose Gregory Chang, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Chemical Shift Encoded MRI (CSE-MRI) allows separation and quantification of water and fat in images. Recent improvements in such methods also allow assessment of fat composition, which may serve as a potential biomarker of osteoporosis. Our purpose is to apply such a method in the proximal femur bone marrow to assess subregional fat quantity and composition in a population of pre and post- menopausal women.

METHOD AND MATERIALS

This study had institutional review board approval and written informed consent was obtained. A multi gradient echo sequence at 3T (scan time = 3:32min) was used to acquire images of both hip of n=7 pre (25.75 +/- 3.58y) and n=6 post-menopausal women (59.83 +/- 3.58y). Using a dedicated reconstruction workflow we quantitatively assessed fat composition in bone marrow adipose tissue (bMAT) as depicted in figure 1. Using k-mean clustering, separation within bMAT of regulated (rMAT) and constitutive marrow adipose tissue (cMAT) was achieved. Regions of interest were draw in the: femoral head (FH), femoral neck (FN), Ward's triangle (WT), greater trochanter (GT), and proximal shaft (PS). The Mann-Whitney non-parametric test was used to compare results between groups.

RESULTS

Within bMAT of FN/WT, patients compared to controls demonstrated: higher SFA (+18.8%/32.1%) and lower PUFA (-30.6%/-

49.7%) and MUFA (-15.6%/-8.61%) (p<0.05 for all). Within rMAT of the FH, FN, WT, and GT patients compared to controsl demostrated: higher SFA (+17.4%/+31.3%), lower PUFA (-38.3%/-59.5%), and lower MUFA (-8.3%/-25.1%) (p<0.05 for all). Within cMAT of FN and WT, patients compared to controls demontrated: higher SFA (+9.7%/+18.8%) and lower PUFA (-22.7%/-33.3%) and MUFA (-6.2%, FN only) (p<0.05 for all).

CONCLUSION

CSE-MRI can separate bMAT into rMAT/cMAT and detect sub-regional variation and differences in proximal femur fat composition and quantity in pre-post menopausal subjects in clinically feasible scan times.

CLINICAL RELEVANCE/APPLICATION

Chemical Shift Encoded MRI allows to assess bone marrow fat quantity and composition and allows discrimination between bone marrow adipose tissues in pre/post menopausal women.

SSA15-04 Quantification of Vertebral Bone Marrow Fat: Comparison of Six-Echo Modified Dixon with Single-Voxel MR Spectroscopy

Sunday, Nov. 26 11:15AM - 11:25AM Room: S406B

Participants

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PURPOSE

To compare lumbar vertebral bone marrow fat-signal fractions obtained from six-echo modified Dixon sequence (6-E mDixon) with fractions from single-voxel MR spectroscopy (MRS) in patients with low back pain

METHOD AND MATERIALS

Vertebral bone marrow fat-signal fractions were quantified by modified Dixon with six-echoes and single-voxel MRS measurements in 23 patients. The point-resolved spectroscopy (PRESS) sequence was utilized for localized single voxel-MRS (TR = 3000 msec, TE = 35 msec, and total scan time = 1 minute 42 seconds). A $2 \times 2 \times 1.5$ mm3 voxel was placed within the L3 vertebral body. The bone marrow fat spectrum was characterized based on the magnitude of measurable fat peaks and an a priori knowledge of the chemical structure of triglycerides. The imaging-based fat-signal fraction results were then compared to the MRS-based results.

RESULTS

There was a strong correlation between modified Dixon and MRS-based fat-signal fractions (slope = 0.842, r2 = 0.869, p < 0.001) (Figure 1). With Bland-Altman analysis, 91.3% (21/23) of data points were within the limits of agreement (Figure 2). Bland-Altman plots showed a slight but systematic error of modified Dixon based fat-signal fraction, which showed a prevailing underestimation of small fat-signal fractions and overestimation of high fat-signal fractions

CONCLUSION

Given its excellent agreement with single voxel-MRS, modified Dixon with six echoes can be used for visual and quantitative evaluation of vertebral bone marrow fat in daily practice.

CLINICAL RELEVANCE/APPLICATION

6-E mDixon allows equally accurate in quantifying vertebral bone marrow fat content as MRS and is potentially suitable for fat quantification in vertebral bone marrow

SSA15-05 Quantitative Standardization of Bone Marrow Imaging of Normal Vertebrae in Adults Using Dual-Source Dual-Energy CT Virtual Noncalcium Technique

Sunday, Nov. 26 11:25AM - 11:35AM Room: S406B

Participants

Hong Wang JR, Jinan, China (*Presenter*) Nothing to Disclose Jiayang Fang, Jinan, China (*Abstract Co-Author*) Nothing to Disclose Dexin Yu, Jinan, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the characteristics of bone marrow imaging and obtain the quantitative standard values of normal vertebrae in adults using dual-energy CT virtual noncalcium (VNCa).

METHOD AND MATERIALS

A total number of 200 cases who took physical examination were recruited to receive thoracolumbar spine imaging with dual-source dual-energy CT between August and November 2016. The CT values of bone marrow of T3-L5 vertebrae body were measured by using VNCa technique. Then on the basis of the measured CT values of vertebral body, four segments including T3-T5, T6-T9, T10-L1 and L2-L5 with approximative CT values were divided. The differences in such measurement parameters between different ages and genders were analyzed. Meanwhile, the average of the radiation dose of the scanning range was recorded.

RESULTS

The CT values of bone marrow in thoracic and lumbar vertebrae in young women were -27.76HU and -37.56HU, higher than those of older women with -37.80HU and -45.45HU (P<0.05). The CT values of the thoracic and lumbar vertebrae were -30.73HU and -33.74HU, which were significantly higher than those of the aged male with -46.07HU and -44.68HU (P<0.05). However, there were

no significant differences of the CT values of bone marrow in thoracic and lumbar vertebrae between the groups regarding gender (P>0.05). The measured CT values of bone marrow were negatively correlated with age (r=-0.4,P=0), while no significant correlation with sex (r=0.08,P=0.252). The average CT values of bone marrow of four segments were significant higher in younger cases between different age groups (P<0.05) and there were no significant differences of the average CT values of bone marrow between the groups regarding gender (P>0.05). In addition, the mean dose of the radiation was 8.33 mSv, which was 62.13% lower than that of the second generation dual source CT radiation.

CONCLUSION

VNCa bone marrow imaging with dual-source dual-energy CT of the quantitative CT value in normal thoracic and lumbar is more stable, and can provide an objective quantitative standard value for vertebral disease diagnosis.

CLINICAL RELEVANCE/APPLICATION

Dual-source dual-energy CT VNCa technique can provide quantitative standard of normal bone marrow which is helpful for the diagnosis of bone marrow lesions rather than using MRI as standard.

SSA15-06 Differential Diagnosis of Osteoblastic Metastases in Patients with Breast and Lung Cancer Using Dual-Energy Spectral CT Imaging

Sunday, Nov. 26 11:35AM - 11:45AM Room: S406B

Participants

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PURPOSE

To assess the diagnostic efficacy of dual-energy spectral CT in the evaluation of osteoblastic metastases (OBMs) in patients with breast cancer or lung cancer.

METHOD AND MATERIALS

17 patients with lung cancer and 21 patients with breast cancer underwent plain and contrast-enhanced CT scans of the thorax, abdomen or spine with dual-energy spectral imaging mode. The osseous metastases were at least 1cm in diameter with a relatively homogeneous density and the final diagnosis of was based on imaging and long-term clinical follow-up. The 140kVp polychromatic images and 11 sets of virtual monochromatic spectral images (40-140keV) for spectral CT in the plain (P), arterial phase (A) and venous phase (V) were evaluated. Regions of interest (ROI) were placed on the osteoblastic metastases covering 2/3 of the lesion and avoiding the bone cortex. The attenuation (CT value) of lesions was measured in all phases, and the increase in CT value (IV) was calculated as [IVAP=CTA-CTP; IVVP=CTV-CTP]. Independent sample t-test was used to compare the attenuation values of polychromatic and monochromatic spectral images. Receiver operator characteristic analysis was performed to compare the area under curve (AUC) for the differentiation of OBMs in patients with breast cancer and lung cancer.

RESULTS

65 OBMs (lung cancer: 38, breast cancer: 27) were confirmed. The CT value (CTP(140kVp), CTA(140kVp) and CTV(140kVp)) and enhancement (IVAP(140kVp) and IVVP(140kVp)) from the conventional 140kVp imaging did not show any significant difference between the two types of OBM, neither did the CT values from VMS images (p > 0.05). However, the enhancement value in venous phase (IVVP) from all monochromatic levels (40-140keV) showed significant difference between the two types of OBM (all p<0.05). Using 14.99HU as a threshold value for IVVP(110 keV), we obtained an AUC of 0.793 for differentiating OBMs from lung cancer(4.81± 17.40 HU) and breast cancer(35.32±46.10 HU), with a sensitivity of 0.778 and a specificity of 0.763.

CONCLUSION

Virtual monochromatic spectral imaging is superior to 140kVp images for the differentiation of OBMs from lung cancer and breast cancer.

CLINICAL RELEVANCE/APPLICATION

Dual-energy spectral CT can be used to help determine the primary source of bone metastasis.

SSA15-07 MRI and PET-CT Imaging Features of MPNST, Borderline and Benign Neurofibromas: Is it Possible to Anticipate Malignant Transformation?

Sunday, Nov. 26 11:45AM - 11:55AM Room: S406B

Awards

Student Travel Stipend Award

Participants

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PURPOSE

-To describe which imaging features are characteristic of benign neurofibromas (BPNST) and which of Malignant Peripheral Nerve Sheath Tumors (MPNST) in patients with and without neurofibromatosis (NF) -To determine which MRI and PET-CT features are characteristic of borderline neurofibromas in NF -To determine if after the first malignant transformation, there is an increased frequency of malignant transformation in other neurofibromas. -To compare imaging features of BPNST and MPNST in patients with and without NF

METHOD AND MATERIALS

This is a retrospective study including patients with pathologically confirmed BPNST or MPNST between 2009 and 2016 who also had an MRI and/or PET-CT done before surgery. <u>Patients characteristics:</u> 60 tumors from 41 patients were included in our study, 19 males and 22 females. 26 patients had a genetically confirmed Neurofibromatosis and 15 patients did not have NF. Among these 60 tumors, 36 were considered BPNST and 24 MPNST. This data could be further divided into patients with and without NF. <u>Imaging characteristics:</u> An MRI previous to the diagnosis was available in all cases. More than one MRI was available in 23 tumors. PET-CT was performed in 20 tumors. <u>MRI assessment:</u> MRIs were reviewed retrospectively by 2 radiologists for the study of: Location, size, cystic/necrotic content, hemorrhage, margins, neighbouring structures, T1/T2 heterogenicity, T1/T2 signal, split-fat/target sign, DWI, ADC, enhancement pattern and edema. <u>Pathology:</u> All the tumors were included in Tissue arrays with a subgroup of 30 potential biomarkers selected.

RESULTS

-Significant differences between MPNST and neurofibromas were found in size, enhancement, perilesional edema, and necrotic areas. Borderline neurofibromas seem to share some of these imaging features, this could help radiologists to differentiate them from other BPNST. -PET-CT is a highly sensitive and specific for the diagnosis of MPNST (SUVmax range=3.77-6.35; mean SUVmax values=5.09). -The first malignant transformation increases the likelihood of degeneration within other neurofibromas.

CONCLUSION

MRI and PET-CT could help to differentiate neurofibromas, borderline neurofibromas and MPNST in NF patients.

CLINICAL RELEVANCE/APPLICATION

This scientific presentation could help radiologists to foresee which tumors will degenerate to MPNST as well as it could help NF patients to avoid multiple surgeries and aggressive treatments

SSA15-08 Retrospective Comparison of MRI Characteristics Distinguishing Lipomas and Well-differentiated Liposarcomas With and Without MDM2 or CDK4 Oncogene Amplification Testing

Sunday, Nov. 26 11:55AM - 12:05PM Room: S406B

Awards

Student Travel Stipend Award

Participants Aaron D. Losey, MD,MS, San Francisco, CA (*Presenter*) Nothing to Disclose Matthew D. Bucknor, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To analyze the MRI characteristics that distinguish lipomas from well-differentiated liposarcomas (WDL). Additionally, to compare the MRI characteristics between lipomas tested or not tested for MDM2 or CDK4 oncogene amplification and WDL tested or not tested for MDM2 or CDK4 oncogene amplification.

METHOD AND MATERIALS

A IRB-approved retrospective review of 115 patients with histologically proven lipomatous tumors was performed. Patients were grouped into lipomas and WDL based on histology, with or without oncogene testing. All patients underwent MRI imaging evaluating for size, location, percentage similar to host adipose tissue, thin or thick septations, nodularity, and enhancement. The associations between these features and tumor diagnoses were analyzed. Additionally, the associations between these features and oncogene testing between subgroups was explored. P < .05 was considered to indicate a statistically significant difference.

RESULTS

Of the 115 patients, 57 were classified as lipomas and 58 as WDL. Of the 57 lipomas, 24 had MDM2/CDK4 testing performed (negative). Of the 58 WDL, 28 had oncogene testing (positive). The mean age for the group with lipomas was 50 +/- 20 years and 60 +/- 14 years for the group with WDL (p=0.002). 46% of the group with lipomas was male and 52% for the group with WDL. The WDL group was more likely have a mass of larger size (p<0.001) and in a location other than the lower extremity (p=0.004) when compared to the lipoma group. There were no other statistically significant differences in the other imaging features. In the lipoma sub-group, lipomas tested for oncogene amplification were more likely to be larger (p<0.001) and demonstrate enhancement (p=0.03) when compared with lipomas not tested. The comparison between WDL tested for oncogene amplification and those not tested did not demonstrate statistically significant MRI characteristics.

CONCLUSION

While some of the imaging features of lipomas and WDL overlap, the WDL group was more likely to be of larger size and in a location other than the lower extremity. Additionally, negative oncogene testing has possibly increased the number of larger and/or enhancing lipomatous tumors that are characterized as lipomas.

CLINICAL RELEVANCE/APPLICATION

It is challenging to definitively characterize lipomatous tumors based on imaging. The use of oncogene testing for lipomatous tumors has altered imaging features associated with lipomas versus WDLs.

SSA15-09 CT Temporal Subtraction Method for Detection of Sclerotic Bone Metastasis in the Thoracolumbar Spine: JAFROC Observer Study

Participants Midori Ueno, MD, Kitakyushu, Japan (*Presenter*) Nothing to Disclose Takatoshi Aoki, MD, PhD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose Hyoungseop Kim, PhD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose Seiichi Murakami, Kitakyusyu, Japan (*Abstract Co-Author*) Nothing to Disclose Takashi Terasawa, MD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose Yukunori Korogi, MD, PhD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose Akitaka Fujisaki, MD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Although CT is a routine imaging modality to survey many types of cancer, bone metastases are often missed at CT because of their subtle findings. We have developed a new temporal subtraction (TS) method in order to significantly reduce misregistration artifacts on the subtraction images in successive thoracic CTs, and have shown that TS can improve the diagnostic accuracy of lung nodules. However, the performance of TS for the detection of the bone metastasis has not been clarified. The purpose of this study is to assess the effectiveness of a CT-TS methods for radiologist's performance in sclerotic metastasis detection in the thoracolumbar spine.

METHOD AND MATERIALS

Twenty pairs of standard-dose 1mm-thick CT and their TS images in patients with sclerotic bone metastasis and 20 pairs of those in patients without bone metastasis were used for an observer performance study. A total of 137 lesions were identified as the reference standard of actionable lesions (sclerotic metastasis newly appeared or increased in size) by two musculoskeletal radiologists. Eight radiologists (four attending radiologists and four radiology residents) participated in this observer study. Ratings and locations of "lesions" determined by the observers were utilized for assessing the statistical significance of differences between radiologists' performances without and with the CT-TS images in JAFROC analysis. The statistical significance of differences in the reviewing time was determined by use of a two-tailed paired Student's t test.

RESULTS

The average figure-of-merit (FOM) values for all radiologists increased to a statistically significant degree, from 0.856 without the CT-TS images to 0.884 with the images (P=.037). The average sensitivity for detecting the actionable lesions was improved from 60.7 % to 72.5 % at a false-positive rate of 0.15 per case by use of the CT-TS images. The average reading time with CT-TS images was significantly shorter than that without (150.6 seconds vs. 166.5 seconds, P=.004).

CONCLUSION

The use of CT-TS would improve the observer performance for the detection of the sclerotic bone metastasis in the thoracolumbar spine.

CLINICAL RELEVANCE/APPLICATION

A CT temporal subtraction method can sufficiently assist not only the radiologists' diagnostic accuracy but also their interpretation time for the detection of sclerotic bone metastasis in the thoracolumbar spine.







SSA16

Science Session with Keynote: Nuclear Medicine (Prostate Cancer Imaging)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S505AB



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

FDA Discussions may include off-label uses.

Participants

Ukihide Tateishi, MD, PhD, Tokyo, Japan (Moderator) Nothing to Disclose

Peter L. Choyke, MD, Rockville, MD (*Moderator*) Researcher, Koninklijke Philips NV; Researcher, General Electric Company; Researcher, Siemens AG; Researcher, iCAD, Inc; Researcher, Aspyrian Therapeutics, Inc; Researcher, ImaginAb, Inc; Researcher, Aura Biosciences, Inc

Sub-Events

SSA16-01 Nucler Medicine Keynote Speaker: Introduction to Prostate Cancer PET Imaging and Theranostics

Sunday, Nov. 26 10:45AM - 10:55AM Room: S505AB

Participants

Steven P. Rowe, MD, PhD, Parkville, MD (Presenter) Nothing to Disclose

SSA16-02 Initial Experience with Commercial 18F-Fluciclovin

Sunday, Nov. 26 10:55AM - 11:05AM Room: S505AB

Participants

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PURPOSE

The non-natural amino acid anti-1-amino-3-18F-fluorocyclobutane-1-carboxylic acid (FACBC, Fluciclovine, Axumin) is a PET tracer approved by the U.S. Food and Drug Administration (FDA) for the detection and localization of biochemically recurrent prostate cancer. While the performance of Axumin PET/CT imaging in clinical trials is well documented, its performance in clinical practice is unknown. We aim to evaluate the positivity rate for the patients scanned with Axumin PET/CT as part of their clinical workup.

METHOD AND MATERIALS

A retrospective review of patients who underwent 18F-Fluciclovine PET/CT (Axumin) imaging at our institution secondary to suspect prostate cancer recurrence based on rising prostate specific antigen (PSA) levels, was conducted between December 2016 through March 2017. Images were interpreted by nuclear medicine board certified and Axumin expert reader physicians. Patient demographics and positivity rate were evaluated.

RESULTS

37 patients (Pts) with a median age of 68 years (range 52-83 years) and most recent mean PSA level of 2.9 ng/ml underwent Axumin imagng. For their initial treatment, 10 pts underwent radical prostatectomy (RP), 7 pts had radiation (RT), 1 pt had hormonal therapy (HT), and 19 pts had combination (12 RP+RT, 4 RP+HT, 2 T+HT, 1 RP+RT+HT). 32/37 pts (86%) had positive Axumin PET/CT scan whereas 5/37 pts (14%) were described as negative. The scan was positive within the prostate bed in 12 pts (37.5%) and extraprostatic lesions were detected in 20 pts (62.5%). In 16 pts with PSA level < 1.0 ng/ml, positivity rate was 75 % (12/16). Indolent suspicious bone lesions noted in 4/37 (11%) pts. Only 2 pts had available biopsy conformation; 1 true positive in the prostate bed and 1 was metastasis to deep pelvic lymph node. 2 pts with positive bone lesions were evaluated with MRI; 1 lesion was defined as false positive with a negative MRI and one defined as true positive with positive MRI. One patient had biopsy that was true positive for a second primary cancer.

CONCLUSION

Initial experience with commercial Axumin PET/CT scan was found to demonstrate high positivity rates in patients with suspected prostate cancer recurrence.

CLINICAL RELEVANCE/APPLICATION

Positivity rate has been described in a selected population under strict clinical trials. Evaluation of the commercially scanned patients will help understand the impact of the scan in clinical practice.

SSA16-03 Correlation of Intraprostatic 68Ga-PSMA11-PET/CT Tracer Uptake with PSA, Gleason Score and d'Amico Risk Classification in Treatment-Naive Men with Newly Diagnosed Prostate Cancer

Sunday, Nov. 26 11:05AM - 11:15AM Room: S505AB

Participants

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PURPOSE

68Ga-PSMA11-PET/CT is an uprising and promising diagnostic tool for patients in recurrent prostate cancer (PCa). However, only limited in vivo data is available evaluating PSMA uptake as a primary diagnostic tool and its correlation with several clinical parameters. Our study evaluates maximal standardized uptake values (SUVmax) in benign prostate tissue and malignant, intraprostatic tumor lesions and its correlation with several clinical parameters (PSA, Gleason Score, d'Amico risk).

METHOD AND MATERIALS

104 treatment-naïve men with biopsy proven prostate carcinoma were included in this study. SUVmax of intraprostatic lesions was measured as indicated by biopsy and MRI-results. Data was compared with current prostate specific antigen (PSA) values, Gleason Score (GS), ISUP-grade and d'Amico risk classification. Furthermore, we evaluated SUVmax-values in patients with clearly delineated benign intraprostatic tissue to determine a cut-off-value for tumor lesion (n = 42).

RESULTS

We measured a mean SUVmax of 1.88 ± 0.44 in benign intraprostatic tissue compared to 10.77 ± 8.45 in malignant, intraprostatic lesions (p < 0.001). A significantly higher PSMA-uptake in PSMA-PET/CT for patients with higher PSA, higher GS and higher risk according to d'Amico was observed (p < 0.001, respectively).

CONCLUSION

68Ga-PSMA11-PET/CT is well suited for the detection of dominant intraprostatic tumor lesion of patients with primary staging. Our findings from a large cohort suggest a significant relation of intraprostatic PMSA-uptake with PSA, GS and d'Amico risk classification. These findings indicate that PSMA-PET/CT could be helpful in various clinical settings, such as biopsy guidance, radiooncological management and further treatment stratification.

CLINICAL RELEVANCE/APPLICATION

68Ga-PSMA-PET/CT offers an excellent diagnostic tool for prostate cancer patients. To our knowledge, there is still limited data regarding intraprostatic tracer uptake and clinical parameters, which might be very useful for treatment planning in radiation oncology or biopsy-guidance. Therefore, we evaluated differences of SUV measurements in malignant and healthy prostate tissue and correlated SUV with Gleason Score, PSA and d'Amico risk classifikation in a large cohort of treatment-naive men with prostate cancer.

SSA16-04 68Ga-PSMA-11 PET/MRI in Primary Intermediate/High-Risk Prostate Cancer

Sunday, Nov. 26 11:15AM - 11:25AM Room: S505AB

Awards

Student Travel Stipend Award

Participants Sonya Y. Park, MD, Stanford, CA (*Presenter*) Nothing to Disclose Claudia Zacharias, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Caitlyn Harrison, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose Lucia Baratto, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose Negin Hatami, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose Andrei Iagaru, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Extensive investigation of 68Ga-PSMA-11 PET has shown high detection rates in men with recurrent prostate cancer after treatment. However, data is limited for evaluation (alone or as a hybrid system) at initial diagnosis. We report the diagnostic performance of 68Ga-PSMA-11 PET/MRI prior to prostatectomy in patients with intermediate or high-risk cancer.

METHOD AND MATERIALS

We recruited twenty men without metastatic disease on conventional imaging (CT or MRI and bone scintigraphy) who were scheduled for radical prostatectomy with pelvic lymph node dissection. A mean dose of 4.2 ± 0.6 mCi (155.4 ± 22.2 MBq) of 68Ga-PSMA-11 was administered. Whole-body images were acquired starting 43-61 minutes post-injection using a GE SIGNA PET/MR, followed by an additional pelvic PET/MRI acquisition (including conventional multiparametric MRI sequences) 42-67 minutes later. PET/MRI findings were compared to preoperative diagnostic MRI and correlated with final pathology.

RESULTS

Preoperative 68Ga-PSMA 11 PET identified intraprostatic cancer foci in all 20 patients, whereas mpMRI alone identified PIRADS 4 or 5 lesions in 16 patients and PIRADS 3 in two patients. PET/MRI demonstrated focal uptake in pelvic lymph nodes in three patients. Final pathology confirmed cancer in the prostate of all patients, as well as nodal metastasis in two. No patient with normal pelvic nodes on PET/MRI had cancer in the nodes on final pathology. Tracer accumulation increased overall at later acquisition times, with higher SUVs (mean: 16.6 vs 13.4, P=0.006). However, no additional lesions were identified on delayed imaging.

CONCLUSION

68Ga-PSMA-11 PET/MRI correctly identifies foci of cancer within the prostate while MRI provides detailed anatomical guidance for the location of abnormal uptake. 68Ga-PSMA-11 PET/MRI provides valuable information even in the setting of negative conventional imaging, and may inform the need for and extent of pelvic node dissection.

CLINICAL RELEVANCE/APPLICATION

68Ga-PSMA-11 PET/MRI offers incremental value over a dedicated prostate MRI and bone scan, and is recommended in the preoperative evaluation of prostate cancer patients.

SSA16-05 Incremental Diagnostic Value of 68Ga-PSMA-HBED-CC PET Imaging over Transrectal Ultrasound-Guided Prostate Biopsy for Prostate Carcinoma

Sunday, Nov. 26 11:25AM - 11:35AM Room: S505AB

Participants

Tung Tsoi, Hong Kong, Hong Kong (*Abstract Co-Author*) Nothing to Disclose Sirong Chen, Hong Kong, Hong Kong (*Presenter*) Nothing to Disclose William Cheung, Hong Kong, Hong Kong (*Abstract Co-Author*) Nothing to Disclose Chi Lai Ho, Hong Kong, Hong Kong (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Transrectal ultrasound-guided biopsy (TRUSGB) for evaluation of prostate carcinoma (PCa) is known to be operator-dependent and subject to sampling errors, sometimes leading to delayed diagnosis and misclassification. In this study, we aim to explore whether 68Ga-PSMA PET has an incremental value over TRUSGB for evaluation of PCa.

METHOD AND MATERIALS

Our study consecutively recruited 38 patients (mean age: 66+/-6 y, range: 55-80 y) to compare their 68Ga-PSMA PET/CT findings with TRUSGB results before radical prostatectomy. SUVmax ratio of lesion to background prostatic tissue (LB ratio) were measured and assessed by receiver-operating characteristic (ROC) curve analysis to determine the cut-off LB ratio for diagnosis of prostate cancer involvement on a lobar basis. The difference in diagnostic accuracy was based on the ability of TRUSGB or PET in diagnosing presence or absence of tumor, and in correct lobar lateralization of tumor when compared with the final gold standard of prostatectomy histopathology.

RESULTS

Prostatectomy histopathology confirmed PCa in 66/76 lobes. TRUSGB detected 49/66 (74.2%). 68Ga-PSMA PET, at a cut-off LB ratio of 1.4, identified 56/66 (84.8%) PCa lobes with specificity 90% (9/10), accuracy 85.5% (65/76) and AUC 0.88. 68Ga-PSMA PET identified 5 PCa lobes in 3 patients having negative TRUSGB results, which prompted for a 2nd biopsy guided by spatial localization with 68Ga-PSMA PET and confirmed the diagnosis of PCa. In addition, 68Ga-PSMA PET/CT identified 8 patients with bilateral PCa involvement who were initially diagnosed as unilateral PCa by TRUSGB. On a lobar bases, the incremental value of 68Ga-PSMA PET over TRUSGB was significant (93.9%, 62/66 vs 74.2%, 49/66, P<0.05). On a patient basis, combined use of two techniques could detect PCa in all patients.

CONCLUSION

Combined use of 68Ga-PSMA PET/CT has an incremental value over TRUSGB alone for diagnosis of PCa. It may also provide valuable localization information for targeted biopsy sampling, especially for the patients with negative initial biopsy or those who are reluctant for biopsy.

CLINICAL RELEVANCE/APPLICATION

68Ga-PSMA PET/CT might increase the accuracy of TRUSGB by providing more accurate PCa location, thus changing the management from passive surveillance to prostatectomy.

SSA16-06 Whole-Body 18F-PSMA-1007-PET/MRI with Integrated Multiparametric Prostate Imaging Protocol for Comprehensive Staging of Patients with Prostate Cancer

Sunday, Nov. 26 11:35AM - 11:45AM Room: S505AB

Participants

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PURPOSE

To explore the feasibility, reproducibility and PET-artifact presence of a 18F-PSMA-1007-PET/MRI protocol for imaging high-risk prostate cancer (PC) patients.

METHOD AND MATERIALS

After 18F-PSMA-1007-PET/CT was performed (1h p.i.) as reference, eight patients with proven high-risk PC underwent a wholebody PET/MRI (3h p.i.) including a multi-parametric PI-RADS 2.0 compliant prostate protocol using a prototype CAIPIRINHAaccelerated attenuation correction. SUVmean-quantification for reproducibility was performed using a 3D-isocontour volume-ofinterest. PET-artifacts (Cohen's kappa), co-registration of prostate PET/MRI (>3mm shift between bladder outline in PET and MRI) and prostate MRI (PI-RADS 2.0) were assessed.

RESULTS

The examinations were well accepted by patients and comprised 1 hour. SUVmean-VOIs between PET/CT (1h p.i.) and PET/MRI (3h p.i.) were linear (PET/CT 9.0 \pm 5.0, PET/MRI 11.4 \pm 6.1, p<0.0001 pathological VOIs and PET/CT 19.6 \pm 7.5, PET/MRI 21.8 \pm 10.4, p<0.0001 physiological VOIs) demonstrating reproducibility. Mostly slight to moderate photopenic artifacts were noticed in PET/MRI in the abdomen, surrounding liver and kidneys (kappa 0.82 (CI 0.62-1.00)) with a mean of 1.13 \pm 0.99 (reader 1) and 1.38 \pm 0.74 (reader 2). Both readers agreed to 100% that the PET-component of the PET/MRI did not reveal any artifacts in head/neck and thorax. Both readers agreed to 100% that the PET-component of the PET/CT did not reveal any artifact in the four compartments defined. All acquisitions of PET and MRI of the prostatic fossa obtained simultaneously could be co-registered with optimal match of bladder volume between both modalities. All patients featured PI-RADS 5 findings.

CONCLUSION

The presented 18F-PSMA-1007-PET/MRI protocol combines efficient whole-body assessment with high-resolution co-registered PET/MRI of the prostatic fossa, cinically feasible in 1 hour. Moderate photopenic artifacts were noticed surrounding high-contrast areas liver and kidneys. This promising protocol is proposed as a comprehensive staging for patients with prostate cancer exploiting the optimal tracer biodistribution of 18F-PSMA-1007 (low bladder clearance) and the combination of T-(MRI) and N-/M-staging (PET and MRI).

CLINICAL RELEVANCE/APPLICATION

We propose an innovative 18F-PSMA-1007-PET/MRI protocol that combines molecular and functional information for comprehensive staging of prostate cancer patients

SSA16-07 Biochemical Recurrence of Prostate Cancer: Initial Results of 18F-PSMA-1007

Sunday, Nov. 26 11:45AM - 11:55AM Room: S505AB

Participants

Frederik L. Giesel, MD, MBA, Heidelberg, Germany (Presenter) Patent application for F18-PSMA-1007

Leon Will, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose

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PURPOSE

The clinical introduction of 68Ga-PSMA-11 relevantly improved prostate cancer imaging. However, 68Ga-labelled tracers are limited by production capacity and short half-life. 18F-labelled ligands such as DCFPyL and PSMA-1007 have benn developed to solve this limitation. Additionally, in the pelvis PSMA-1007 benefits from low kidney clearance resulting in almost no urinary bladder uptake of tracer-associated activity. In this study, we analyzed the diagnostic potential of PSMA-1007 in PCa patients with biochemical recurrence (BCR).

METHOD AND MATERIALS

Seven patients (median age 72) with BCR (PSA mean = 1.78 ng/mL) underwent PET/CT-scans 1h and 3h after injection of 18F-PSMA-1007 (mean injection activity: 247 MBq). Biodistribution in normal organs as well as tumor uptake and lesion morphology (size) were examined.

RESULTS

PSMA-1007 was tolerated well in all 7 patients without any adverse events. PSMA PET/CT detected local recurrence (n=2; PSA 1.9 and 3.6 ng/ml), lymph node metastases (n=2; PSA 0.16 and 2.0 ng/ml), and bone metastases (n=1; PSA 3.8 ng/ml). In two patients suspective PET-positive findings were not observed (n=2; PSA 0.4 and 0.5 ng/ml). In all tumor lesions tracer uptake increased from 1h p.i. (mean SUVmax 8.4) to 3h p.i. (mean SUVmax 14.1). Histological validation of one patient with LN-metastases and response to succeeding radiotherapy confirmed true-positive findings clinically; distant metastases were not confirmed and treated with androgen-deprivation therapy. The diagnosed LN-metastases were below radiological criteria (SAD median = 5.2 mm, minimum = 3.5 mm) and focal therapy would not have been an option with conventional staging alone.

CONCLUSION

In this pilot study 18F- PSMA-1007 PET/CT presented high potential for non-invasive localization diagnostics in prostate cancer patients with BCR. Local recurrence was well delineable due to the low urine activity background in bladder and urethra and might present advantageously in comparison to other PSMA radiotracers in this setting.

CLINICAL RELEVANCE/APPLICATION

18F-PSMA-1007 performs at least comparably to 68Ga-PSMA-11, but its longer half-life, superior engery characteristics and nonurinary excretion might overcomes some practical limitations of 68Ga-labelled PSMA-targeted tracers.

SSA16-08 Quantitative Multiparametric MRI and DCFBC PET/CT in Primary Prostate Cancer: Combined Association for Identification of Aggressive Disease

Sunday, Nov. 26 11:55AM - 12:05PM Room: S505AB

Participants

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PURPOSE

Multiparametric MRI (mpMRI) is often used in diagnosing prostate due to its high sensitivity, but suffers from low specificity regarding assessment of disease aggressiveness. Molecular imaging agents such as Prostate Specific Membrane Antigen (PSMA) targeting by 18F-DCFBC PET/CT have shown progress in defining aggressive cancer phenotypes. The purpose of this study is to correlate quantitative information from MRI and PET data to determine if the combination can provide better characterization of the cancer phenotype.

METHOD AND MATERIALS

Thirteen patients with localized prostate cancer underwent both mpMRI and 18F-DCFBC PET/CT scans followed by targeted TRUS/MRI guided biopsy or radical prostatectomy. Registered PET/mpMRI images were correlated with pathology. For each lesion, mean and 10th percentile ADC from mpMRI, maximum and mean Standardized Uptake Value (SUV) from 18F-DCFBC PET/CT were calculated. ADC and SUV values were correlated on voxel-level and ROI-level using spearman's rank and each with Gleason score using kendall's tau. Ability of mpMRI and 18F-DCFBC PET metrics to predict Gleason scores >=4+3 was assessed by logistic regression, using generalized estimating equation to account for intra-patient correlation.

RESULTS

Twenty-five lesions were identified by two blinded reviewers across both modalities with sensitivity in lesion detection on mpMRI superior to 18F-DCFBC PET/CT (96% vs. 36%). Quantitative analysis was feasible in 22 lesions. SUVmax and ADC10 showed moderate correlations with Gleason scores (τ =-0.36-0.4), additionally showing a weak correlation to one another (ρ =0.26). These metrics significantly distinguished between Gleason <=3+4 (N=10) or >=4+3 (N=12) in univariate logistic regression model. In a bivariate model, higher SUVmax remained significantly associated with Gleason >=4+3 (SUVmax log-odds ratio 1.84, p=0.02; ADC10 log-odds ratio -0.512, p=0.09).

CONCLUSION

18F-DCFBC PET/CT showed poor sensitivity in detecting all malignant lesions; however, when combined with mpMRI, SUV was significantly associated with aggressive prostate cancer (Gleason >=4+3). The results of this preliminary analysis form the basis for an expanded study with immunohistochemical staining for key driver proteins.

CLINICAL RELEVANCE/APPLICATION

Identification of aggressive phenotypes is critical for understanding prostate cancer progression, correlation of multiple staging scans can provide enhanced characterization beyond either alone.

SSA16-09 177Lutetium PSMA Radioligand Therapy in Patients with Metastatic Castration Resistant Prostatic Cancers: Assessment of Response, Clinical Evaluation, Toxicity - First Study in India

Sunday, Nov. 26 12:05PM - 12:15PM Room: S505AB

Awards

Trainee Research Prize - Resident

Participants

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PURPOSE

RLT with 177-Lu-DKFZ-617-PSMA is a novel targeted therapy for mCRPC. To assess the efficacy of single infusion of 177-Lutetium-DKFZ-617-PSMA Radioligand Therapy by prostate specific antigen (PSA), biochemical, clinical and radiological responses, and early side effects.

METHOD AND MATERIALS

RLT with 177-Lu-DKFZ-617-PSMA was performed in 11 mCRPC patients. 68GaHBED-CC PET-CT was performed in all patients prior to one cycle RLT (Mean administered activity 7.03 GBq and range 6.67 - 7.4 GBq). In addition, early response was evaluated by serum PSA levels, CBC, LFT, RFT, serum electrolytes, LDH, ionsed calcium prior to and followed by 2, 4, 6 and 10 weeks post therapy.

RESULTS

All lesions detected by 68Ga-HBED-CC PSMA PET-CT exhibited high 177-Lu-DKFZ-617-PSMA uptake on post therapy planar and SPECT images. 10 weeks after therapy 7 patients (63.63%) experienced PSA decline of whom 2 patients (18.18%) experienced more than 50% PSA decline and 4 patients (36.36%) experienced rise in PSA out of which 3 patient (27.27%) experienced more than 30 % raise in PSA. Relevant hematotoxicity (ECOG CTC and CTCAE) i.e. grade 3 / 4 anemia in 18.18% and grade 1 / 2 in 27.27%, and grade 3 / 4 thrombocytopenia in 18.18 %, and grade 1 / 2 leucopenia in 27.27% has experienced. 3 patient (27.27%) experienced deranged LFT by grade 1 / 2. One patient (9.09%) has experienced grade 1 changes in RFT . Hyponatremia grade 3 / 4 experienced in 18.18%. and grade 2 in 9.09%, hypocalcaemia grade 2 in 9.09%, and hypophosphatemia grade 1 in 9.09% of patients. There is grade 4 raise in LDL seen in 9.09% patients, grade 3 raise in ALP in 18.18% and grade 1 in 27.27% patients are seen, whereas low ionized calcium with grade 1 changes are seen in 27.27% patients. Xerostomia was experienced by 4 patients (36.36%).

CONCLUSION

177-Lu-DKFZ-617-PSMA RLT is a novel and promising treatment for mCRPC. Our initial results indicate that 177-Lu-DKFZ-617-PSMA RLT is safe, effective and have low early side effect profile. A relevant PSA decline was detected in 63.63 % of patients with six month progression free survival.

CLINICAL RELEVANCE/APPLICATION

(dealing with prostate cancer) '68Ga-HBED-CC PSMA PET-CT study demonstrate upstaging as compared to conventional FDG PET CT. All lesions detected by 68Ga-HBED-CC PSMA PET-CT exhibited high 177-Lu-DKFZ-617-PSMA uptake on post therapy planar and SPECT images. This scan and therapy is highly recommended in the management of prostate cancer.



KSNA° 2017

103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA17

Neuroradiology (Brain Tumors: Beyond the Frontier)

Sunday, Nov. 26 10:45AM - 12:15PM Room: N228

MR NR

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

FDA Discussions may include off-label uses.

Participants

Shinji Naganawa, MD, Nagoya, Japan (*Moderator*) Nothing to Disclose Christopher T. Whitlow, MD, PhD, Winston-Salem, NC (*Moderator*) Nothing to Disclose

Sub-Events

SSA17-01 Non-invasive Prediction of Isocitrate Dehydrogenase (IDH) Genotype in Grade-II Gliomas with Amide Proton Transfer-Weighted (APTw) MR Imaging

Sunday, Nov. 26 10:45AM - 10:55AM Room: N228

Participants

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PURPOSE

Mutations in isocitrate dehydrogenase (IDH) genes are associated with favorable prognosis in patients with gliomas. Compared to oncogenic HRAS IDH1-wild type glioma cells, global downregulation of protein expression in mutant IDH1-driven glioma cells was found. Amide proton transfer-weighted (APTw) imaging is a molecular technique that gives contrast based in large part on endogenous cytosolic proteins and peptides. This study is to test the hypothesis that APTw signal is a surrogate imaging maker for identifying IDH mutation status preoperatively.

METHOD AND MATERIALS

Patients with suspected low-grade glioma were scanned at 3T clinical MRI scanner. APTW images were calculated using MTRasym(3.5ppm). Operative tissue samples were processed IDH1-R132H evaluation, which was performed by IHC and DNA sequencing, as described previously. Quantitative APTw parameters obtained from multi-ROI-based (maximum and minimum) and whole-tumor histogram-based (mean, variance, skewness, kurtosis, slop, 10th percentile, 50th percentile, 90th percentile, and peak) APTw metrics were compared between IDH-mutant and IDH-wildtype groups. Mann-Whitney test was used to evaluate the difference of APTw parameters between two glioma groups, and the receiver-operator-characteristic (ROC) analysis was used to assess the APTw diagnostic performance.

RESULTS

27 patients fulfilled eligibility criteria were recruited. Seven cases were diagnosed as IDH-wildtype grade-II gliomas, and 20 cases as IDH-mutant grade-II gliomas. The maximum and minimum APTw values based on multiple regions of interest, as well as the whole-tumor histogram-based mean and 50th percentile APTw values were significantly higher in the IDH-wildtype gliomas than in the IDH-mutant groups, corresponding to the areas under the ROC curves of 0.80, 0.91, 0.75, and 0.75 respectively, in predicting the IDH mutation status.

CONCLUSION

IDH-wildtype lesions were associated with relatively high APTw signal intensities, compared with IDH-mutant lesions. APTw imaging has the potential for discriminating IDH genotypes in grade-II gliomas non-invasively.

CLINICAL RELEVANCE/APPLICATION

The APTw signal could be a valuable imaging biomarker by which to identify IDH1 mutation status in grade-II gliomas without surgery, which could provide supplementary information about the diagnosis.

SSA17-02 MGMT Promoter Methylation Assessment of Glioblastoma Using Three-Dimensional Texture Features

of Multimodal MRI

Sunday, Nov. 26 10:55AM - 11:05AM Room: N228

Participants

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PURPOSE

O6-methylguanine methyl transferase (MGMT) gene promoter status are significant for treatment strategy and prognosis prediction of patients with glioblastoma(GBM). We aimed to verify that texture features derived from multimodal magnetic resonance images (MRI) may be potential for noninvasive and well-repeatable detection of MGMT promoter methylation status.

METHOD AND MATERIALS

Total 73 patients with GBM were enrolled (35 and 38 with and without MGMT promoter methylation, respectively). For each patient, volumes of interest (VOIs) were delineated on ten MRI modalities or parametric maps. Three-dimensional (3D) grey-level cooccurrence and curvature co-occurrence matrix (GLCM and GLGCM) textural features were extracted from each VOIs. Then the support vector machine (SVM) based feature selection and classification strategies were proposed to firstly obtain an optimal feature subset and then verify and improve its capacity to identify whether the patient was with MGMT promoter methylation or not, corresponding receiver operating characteristic (ROC) curve were depicted.

RESULTS

Total 420 3D GLCM and GLGCM features were extracted from ten MRI modalities/parametric maps for each of the 73 patients. After feature selection, 23 features were determined as the optimal feature subset, and the accuracy, sensitivity, specificity and area under ROC curve for identifying MGMT promoter methylation reached to 82.19%, 83.78%, 80.56% and 0.9204, respectively. In optimal subset, features derived from structure and perfusion modalities contributed more in detecting MGMT promoter methylation of GBM, comparing with those derived from diffusion modalities.

CONCLUSION

In this study, an optimal subset of 23 features was selected and its classification performance indicated that they may be a potential imaging biomarkers for predicting MGMT promoter methylation status.

CLINICAL RELEVANCE/APPLICATION

1. For patients with glioblastoma, MGMT promoter status assessment is crucial because MGMT methylation is associated with better prognosis and chemotherapy response. 2. The proposed radiomics approach based on multimodal MRI has the potential to accurately assess the MGMT promoter status before clinical intervention. 3. Texture features derived from structure and perfusion modalities contributed more to MGMT promoter methylation detection of patients with glioblastoma, comparing with those derived from diffusion modalities

SSA17-03 Texture Analysis of Quantitative Apparent Diffusion Coefficient Maps to Differentiate Between High-Grade Gliomas and Metastatic Brain Tumor

Sunday, Nov. 26 11:05AM - 11:15AM Room: N228

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To evaluate the diagnostic value of texture parameters of Apparent Diffusion Coefficient(ADC) maps to differentiate between Highgrade gliomas(HGG) and brain metastasis(METS)

METHOD AND MATERIALS

The ADC maps of the Diffusion Weighted Images of 82 patients of which 50 were pathologically confirmed with HGG and 32 with METS were recorded using ADW 4.6 workstation Functool2 software. Using Omnikinetics Software, 3D merged Region Of Interests images of intratumoral and peritumoral regions were delineated. The texture parameters namely First order parameters including MIN, MAX, MI, skewness, kurtosis, MD, RD, VVS, RMS, uniformity, VC; Grey-level co-occurence matrix parameters including energy, entropy, correlation, IDM, CP and Grey-level run length maxia parameters including GLN, RLN, LGLRE, HGLRE, SRLGLE, SRHGLE, LRLGLE and LRHGLE were reported. Shapiro-Wilk test for normality and independent sample t-test (parametric) and Mann-Whitney u test(non-parametric) were carried out for statistical analysis(spss 20.0). Logistic regression tests were used to evaluate

independent risk factors. ROC curve tests were performed to calculate AUC, cut-off values, sensitivity and specificity.

RESULTS

1) VC (p=0.009), VVS (p=0.013), RMS(p=0.000), RD (p=0.042), correlation(p=0.016), energy(p=0.000), Entropy(p=0.000), GLN (p=0.009), RLN (p=0.005), LGLRE (p=0.023), SRLGLE (p=0.030), LRLGLE (p=0.000) and LRHGLE (p=0.000) between HGG and METS are statistically significant. 2) Mean \pm S.D. values of MIN, MAX, MI, MD, skewness, Kurtosis, VC, RMS, uniformity, RD, entropy, correlation, IDM, CP, GLN, RLN, HGLE, SRHGLE and LRHGLE of HGG are higher than METS. 3) Logistic regression tests suggest VC(p=0.009), VVS(p=0.010), RMS(p=0.000), GLN(p=0.010) and RLN(p=0.005) to contribute significantly to accurate prediction as independent risk factors with a joint model prediction accuracy of 93.9%. 4) ROC curve analysis shows AUC=0.955, 0.684, 0.672, 0.671, 0.663, 0.659 & 0.634 and sensitivity = 91.8%, 81.6%, 77.6%, 67.3%, 75.5%, 79.6%& 67.3% for entropy, RLN, VC, GLN, VVS, correlation & RD respectively.

CONCLUSION

Texture analysis parameters of quantitative ADC maps based on entire tumor serves as good differentiating diagnostic indices of HGG and METS.

CLINICAL RELEVANCE/APPLICATION

Whole Tumor ADC map differentiation of HGG and METS (appear similar on CT/MR imaging but follow different treatment protocols) using texture analysis can improve treatment and therapeutic response.

SSA17-04 Detection of 2-Hydroxyglutarate Using Spectral Editing MRS in Patients with IDH Mutant Gliomas

Sunday, Nov. 26 11:15AM - 11:25AM Room: N228

Participants

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PURPOSE

To assess the diagnostic accuracy of in vivo MRS for the detection of the tumor specific imaging marker D-2-hydroxyglutarate (2-HG) produced by IDH mutant gliomas.

METHOD AND MATERIALS

We prospectively enrolled 14 preoperative patients with grade II or III diffuse gliomas. Each patient underwent an MR examination which included a spectral editing MRS (MEGA-PRESS) to edit the 2-HG Ha resonance at 4.02 ppm, dynamic contrast-enhanced (DCE) imaging and multi-b value diffusion-weighted imaging on a 3T MR scanner. Automatic shimming was performed using the vendor's pre-scan shimming routines. Parameters for the MEGA-PRESS sequence were: TR=2000ms, TE=60ms, 64 acquisitions, voxel size=8 cm3, duration=4.5min. The 2HG Ha resonance of the substracted MEGA-PRESS spectra was analyzed using jMRUI v5.2. Plasma volume (Vp) and volume transfer constant (Ktrans) were calculated from DCE-imaging. Apparent diffusion coefficient (ADC) values were obtained from diffusion-weighted imaging. A radiologist blinded to the IDH status placed multiple small region-of-interests on the Vp, Ktrans and ADC maps. The maximum Vp/Ktrans and the minimum ADC values were kept for each patient ("hot spot analysis"). Following the biospy or surgical resection, a neuropathologist determined the grade and type of glioma using the 2016 WHO classification. IDH mutation status was identified via immunohistochemical detection of IDH1 R132H.

RESULTS

Of the 14 patients, there were 7 with grade III anaplastic astrocytomas, 4 with grade III anaplastic oliodendrogliomas, 2 with grade II astrocytomas and 1 patient with grade II oligodendroglioma. Ten patients harbored the IDH mutations and 4 patients were IDH wild-type. For the detection of 2-HG, MRS had a 40% sensitivity, 100% specificity, 100% postitive predictive value and 40% negative predictive value. From the hot-spot analysis, there was no significant difference between Vp, Ktrans and ADC values between IDH mutant and wild-type gliomas (P=0.88, P=0.06 and P=0.78 respectively).

CONCLUSION

Spectral eding MRS can detect 2-HG in patients with IDH mutant gliomas with high specificity. In the future, the sensitivity of this technique may be improved by using a larger voxel size, increasing the number of acquisitions or performing manual shimming.

CLINICAL RELEVANCE/APPLICATION

Spectral editing MRS can be used to preoperatively detect IDH mutant positive status in patients presenting with a newly suspected glioma.

SSA17-05 Non-Invasively Detecting Isocitrate Dehydrogenase 1(IDH1) Mutation Using Non-Gaussian Diffusion MR Imaging in Lower-Grade Gliomas: Primary Results

Sunday, Nov. 26 11:25AM - 11:35AM Room: N228

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PURPOSE

To explore the feasibility of non-invasively detecting the status of isocitrate dehydrogenase 1 (IDH1) mutation using non-Gaussian diffusion MR imaging in lower-grade gliomas (LGG) including grade2and grade 3.

METHOD AND MATERIALS

Ninety cases with pathologically confirmed lower-grade glioma (WHO grade2:n=64;WHO grade 3:n=26) were enrolled in this prospective study, who performed the uniformed imaging protocol of T1WI, T2WI, T2-Flair , DWI with 2 b values (0, 1000 s/mm2) and 22 b values (<=5000 s/mm2), and contrast-enhanced T1WI (CE-T1WI),respectively. Based on the results of the immunohistologic chemistry staining, the IDH1 status was divided into two groups of mutated-type (IDH1mut) and wild-type (IDH1wild) for each grade. In tumor regions, ADC (apparent diffusion coefficient) and stretched exponential-derived intravoxel heterogeneity index a were extracted to make comparisons between two groups of IDH1mut and IDH1wild for each grade. ROC curve analyses were used to compare the capability of differentiating gliomas of IDH1mut from IDH1wild.

RESULTS

64 grade2gliomas were divided into two groups of IDH1mut (n=41) and IDH1wild (n=23), and 26 grade 3 gliomas were divided into two groups of IDH1mut (n=8) and IDH1wild (n=18). In grade2gliomas, there were significantly increased values of ADC (mm2/s) and a for groups of IDH1mut than IDH1wild (ADC: [1.33 ± 0.322] vs. [1.09 ± 0.232] for IDH1mut (t=3.316, P=0.003) ;a: [0.87 ± 0.054] vs. [0.82 ± 0.050] for IDH1wild (t=3.788, P=0.000). In grade 3, the value of a significantly increased for groups of IDH1mut than IDH1wild (a: [0.83 ± 0.042] for IDH1mut vs. [0.77 ± 0.051] for IDH1wild with P value of 0.008) and no significant difference was shown for ADC ([1.04 ± 0.313] for IDH1mut vs. [0.95 ± 0.154] for IDH1wild with P value of 0.476. ROC analyses showed diagnostic ability of IDHmut for in both grades of gliomas and ADC had the diagnostic ability of IDHmut in grade2gliomas.

CONCLUSION

Non-Gaussian-derived parameter a may identify the status of IDH1 mutation in LGGs with better performance than ADC. In LGG, the water molecules behave more inhomogeneously in groups of IDH1wild than IDH1mut.

CLINICAL RELEVANCE/APPLICATION

The patients with IDH-mutated gliomas can survive much longer than those with IDH non-mutated. Especially for those patients who want conservative treatment and refuse biopsy, they can benefit a lot from non-invasive integrative diagnosis.

SSA17-06 In Vivo Characterization of Macrophages in Adult High Grade Gliomas Using Ferumoxytol-Enhanced MRI

Sunday, Nov. 26 11:35AM - 11:45AM Room: N228

Participants

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PURPOSE

Macrophages are a key component of tumor-associated inflammation and play a significant role in angiogenesis, progression, and metastasis as well as in tumor response to therapy. Ferumoxytol-enhanced MRI (feMRI) has been widely used for macrophage imaging in preclinical studies but not in the clinical neuro-oncology setting. The purpose of our study is to establish feMRI as a noninvasive imaging biomarker of macrophages in adults with high grade gliomas (HGGs).

METHOD AND MATERIALS

In this IRB-approved prospective pilot study at an academic institution, adults with newly diagnosed and recurrent HGGs were enrolled. Each patient had an intravenous ferumoxytol infusion (5 mg/kg) and a subsequent MRI (including QSM and R2* maps) performed at least 16 hours later. Two different sites were chosen within each tumor on feMRI for intraoperative sampling. Each sample acquired was stained with a mix of Prussian Blue, CD68, CD163, and GFAP to determine the location of iron and number of iron-containing macrophages per 20 hpf. Using saved images from surgery and Osirix software, ROIs were reproduced at the sampled sites and in the corpus callosum (to normalize the values for each patient) on QSM and R2* maps. Pearson correlation coefficient/regression analysis was used to determine the relationship between QSM and R2* values and number of iron-containing macrophages present.

RESULTS

8 patients (mean age: 58.6 years, range 32-74 years, 5:3 females:males) with HGGs (5 glioblastomas, 1 gliosarcoma, 1 anaplastic astrocytoma, and 1 anaplastic oligodendroglioma) were included in the analysis. On histopathology across all patients, iron particles were only found in CD68+/CD163+ macrophages; none were found elsewhere including GFAP+ glial/astrocytic cells. There were strong, positive correlations that were statistically significant between both the normalized susceptibility (QSM) and R2* values and the number of iron-containing macrophages (r=0.73, p=0.002, for both analyses).

CONCLUSION

Ferumoxytol-enhanced MRI can be used to detect and quantify macrophages in high grade gliomas, with increasing QSM and R2* values strongly correlating with increasing number of iron-containing macrophages.

CLINICAL RELEVANCE/APPLICATION

Ferumoxytol-enhanced MRI with QSM and R2* correlates well with iron-containing macrophages in brain tumors, and this tool can be used as a noninvasive imaging biomarker of tumor-related inflammation.

SSA17-07 Quantitative Study Noninvasively Prediction of Glioma IDH1 Gene Status by APT Combined with ASL Imaging

Sunday, Nov. 26 11:45AM - 11:55AM Room: N228

Participants

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PURPOSE

The purpose of this part was to explore whether amide proton transfer (APT) and arterial spin labeling imaging (ASL) helped to noninvasively detect isocitrate dehydrogenase 1 (IDH1) gene status in glioma.

METHOD AND MATERIALS

Patients who suspected glioblastoma underwent APT and ASL examination from December 1, 2014 to October 31, 2016, were prospectively collected. MTRasym (3.5 ppm) values (APT values) and CBF values were measured in the tumor parenchyma region. As the lesional CBF value normalized by contralateral cerebellar hemisphere, the normalized CBF was calculated according to the formula nCBF = CBF tumor / CBF cerebellum. All of the patients had the pathological diagnosis and anti-IDH1 R132H antibody immunohistochemical results. The differences between wild type and mutant IDH1 were analyzed by independent sample t test. The receiver operating characteristic curve (ROC) is used to describe the discriminant image parameters. Calculate the cutting value and sensitivity, specificity.logistics regression analysis combined with the effective parameters of APT and ASL to calculate the overall correct prediction rate.

RESULTS

There were 90 patients with both APT and ASL data. In low-grade glioblastoma, the APT and nCBF values of wild-type IDH1 gene were higher than those of IDH1 mutant group (p = 0.027, p<0.001). The area under the ROC curve were 0.802, 0.844, when the cutoff was APT = 1.35 (%) and nCBF = 1.74, the sensitivity was 97%, 81.80%, the Specificity was 60.2% and 62.2%. In the high-grade glioma group, the APT and CBF values of IDH1 gene-type glioma were higher than those of IDH1 mutant. The difference was statistically significant (p = 0.004, p = 0.005); The area under the ROC curve was 0.695 and 0.712, respectively. When the cut value was APT = 3.24 (%), the sensitivity and specificity were 67.4% and 72.2%, respectively. In low-grade glioblastoma, Logistics regression combined with APT values and nCBF values to obtain the overall correct prediction rate is 78.7%; High grade glioma group, combined APT value and CBF value to obtain the overall correct prediction rate is 86.8%.

CONCLUSION

APT and ASL provide a valuable new method for the noninvasive diagnosis of the IDH1 gene state of brain glioma, and the combination of APT and ASL can improve the overall prediction rate of glioma IDH1 gene.

CLINICAL RELEVANCE/APPLICATION

no

SSA17-08 Establishing the Optimal Volumetric Threshold for Determining Progressive Disease in Patients with Recurrent Glioblastoma

Sunday, Nov. 26 11:55AM - 12:05PM Room: N228

Awards

Student Travel Stipend Award

Participants

Renske Gahrmann, MD, Rotterdam, Netherlands (*Presenter*) Nothing to Disclose Martin van den Bent, Rotterdam, Netherlands (*Abstract Co-Author*) Research support, F. Hoffmann-La Roche Ltd Speaker, F. Hoffmann-La Roche Ltd B. van der Holt, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose R. Vernhout, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose W. Taal, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose J.c. de Groot, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose Maaike Vos, The Hague, Netherlands (*Abstract Co-Author*) Nothing to Disclose J. Buter, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose Zwenneke H. Flach, MD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Response to treatment in glioblastoma (GBM) is currently measured in 2D. Volumetric methods are potentially more reliable and accurate for assessing progressive disease (PD), but the optimal threshold for assessment for progression has not been established. We investigated the influence of using different thresholds for determining PD for both enhancing and non-enhancing (FLAIR) lesions to predict overall survival (OS) in recurrent GBM.

METHOD AND MATERIALS

Patients were recruited from a phase II-trial (n=148) in which treatment with lomustine and/or bevacizumab was given in first recurrent GBM. Total volume of enhancing and FLAIR lesions was measured separately using Brainlab semi-automated software. Percentage change in volume from baseline to first and second follow-up (6 and 12 weeks) was calculated. The effect of new lesions and of using different thresholds (10-40%) for determining PD was determined with cox regression analyses.

RESULTS

Due to missing MRI-data (3D T1w post-contrast and/or FLAIR-images), a varying number of patients were excluded from the analyses at 6 and 12 weeks (table). Patients with a new lesion at first follow-up (n=12) had significantly worse OS: hazard ratio (HR)=7.63, p<.001. These patients were further not included in the volumetric threshold analyses. At first follow-up, the highest HR was found using 20% increase as a threshold: HR=1.68 (p=.033) for enhancing (n=111) and HR=2.26 (p=.004) for FLAIR lesions (n=90). The presence of a second follow-up scan was associated with significantly improved OS (n=148): HR=3.23, p<.001. At second follow-up, HRs were somewhat higher than at first follow-up, both compared with baseline: HR=1.98 (p=.003) for enhancing (n=109) and HR=2.624 (p<.001) for FLAIR (n=92) lesions.

CONCLUSION

A 20% increase in enhancing or FLAIR volume best predicts OS at 6 weeks follow-up. When change in volume is measured at 12 weeks follow-up, predictions of OS improved, with lower thresholds (10-15%) showing the best results. A 3-month endpoint could therefore be considered in phase II studies on recurrent glioblastoma.

CLINICAL RELEVANCE/APPLICATION

Volumetric tumor measures in glioblastoma could increase accuracy over the current 2D assessment. We investigate the optimum volumetric threshold for determining progressive disease.

SSA17-09 Diffusion Weighted Imaging of Intracranial Hemangiopericytomas

Sunday, Nov. 26 12:05PM - 12:15PM Room: N228

Awards

Student Travel Stipend Award

Participants Alex El-Ali, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose Andrew R. Thomas, MD, Vienna, WV (*Abstract Co-Author*) Nothing to Disclose Ronald Hamilton, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose Christopher G. Filippi, MD, Grand Isle, VT (*Abstract Co-Author*) Research Consultant, Regeneron Pharmaceuticals, Inc Research Consultant, Syntactx, LLC Vikas Agarwal, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Intracranial Hemangiopericytomas (IHP) are aggressive dural based tumors which are difficult to differentiate from more benign meningiomas. Herein we present the largest series of IHPs to date focusing on MR imaging characteristics to differentiate these tumors from meningiomas.

METHOD AND MATERIALS

Multicenter retrospective review of institutional pathology databases/PACS for cases of IHP (WHO Grade II and III) and meningiomas (WHO Grade I and WHO grade II) from 2005-2016 was performed. Patients without relevant pre-operative MR imaging (T1, T2, DWI and post-contrast T1) were excluded. Imaging evaluation consisted of volumetric analysis, ADC value assessment on diffusion-weighted sequences, and qualitative imaging assessment (T1, T2 and contrast enhancement and presence of flow voids). ADC values were assessed using ROIs (100mm diameter) in the most homogeneous portions of the tumors. ADC values of normal appearing contralateral white matter were used to calculate the ADC-tumor/ADC-white matter ratio. Groups were compared using an unpaired two-tailed student's t-test and one way ANOVA.

RESULTS

Of the 26 patients identified with histologically confirmed IHP, 21 had relevant pre-operative MR imaging for review (14 WHO Grade II, 7 WHO Grade III) and comprised the study population. 48 patients with histologically confirmed WHO Grade I (25) and WHO Grade II (23) meningiomas had relevant pre-operative MR imaging for review and comprised the control population. The study population was 63% male (avg age, 53, range: 22-78) and control population was 52% male (avg age, 55, 20-69). Most IHPs demonstrated flow voids (71%), an uncommon finding in meningiomas (4%) (p<0.01). 57% of IHP tumors demonstrated significantly elevated (ADC-tumor/ADC-normal WM >1.1) ADC ratios. Average ADC-tumor/ADC-WM ratio was 1.26 for IHPs compared to 1.09 for meningiomas (p=0.08). A significant difference between IHPs (ratio:1.26) and WHO Grade I Meningiomas (ratio:1.05) was apparent (p=0.04).

CONCLUSION

This series is the largest to date evaluating the MD imaging characteristics of THDs. Our findings suggest that THDs demonstrate

increased diffusivity relative to meningiomas (p=0.08). The difference is most pronounced between IHPs and WHO grade I meningiomas (p=0.04).

CLINICAL RELEVANCE/APPLICATION

DWI may be a useful diagnostic tool for the radiologist to suggest the diagnosis of intracranial hemangiopericytoma on preoperative MR imaging.





103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA18

Neuroradiology/Head and Neck (Head and Neck Neoplasms)

Sunday, Nov. 26 10:45AM - 12:15PM Room: N229



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

FDA Discussions may include off-label uses.

Participants

Suresh K. Mukherji, MD, Northville, MI (Moderator) Nothing to Disclose

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Sub-Events

SSA18-01 NI-RADS Performance on First Post-Treatment FDG-PET/Contrast-Enhanced CT in Head and Neck Squamous Cell Carcinoma to Detect Residual Disease: ROC Analysis of Surgical and Non-Surgical Treatment Groups

Sunday, Nov. 26 10:45AM - 10:55AM Room: N229

Awards

Student Travel Stipend Award

Participants Derek Hsu, Atlanta, GA (*Presenter*) Nothing to Disclose Falgun H. Chokshi, MD, Marietta, GA (*Abstract Co-Author*) Nothing to Disclose Patricia A. Hudgins, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose Jonathan J. Beitler, MD, MBA, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose Mihir R. Patel, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose Ashley H. Aiken, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The diagnostic performance of the recently published Neck Imaging Reporting & Data System (NI-RADS) for head & neck squamous cell carcinoma (HNSCC) surveillance using post-treatment FDG-PET/Contrast-Enhanced CT (PET/CECT) is undetermined based on treatment type. We aimed to perform a ROC analysis to compare diagnostic performance of NI-RADS for detection of residual disease at both the primary site & in neck nodes in patients with HNSCC treated with either 1) chemoradiation therapy (CRT) alone or 2) surgery +/- CRT.

METHOD AND MATERIALS

A search of an IRB designated quality database for NI-RADS reports on all PET/CECT of the neck from 6/2014 to 7/2016 yielded 418 patients. Inclusion criteria were first time primary HNSCC, a 12- week first post-treatment PET/CECT & a minimum of 9-months of post-treatment follow-up. The electronic health record was reviewed for patient information including treatment modality, pathology results, and clinical and radiologic follow-up. Receiver Operator Curves (ROC) & Area Under Curve (AUC) were derived with 95% confidence intervals. AUCs were compared (Delong method). P-values <0.05 were significant.

RESULTS

Of 182 patients meeting inclusion criteria, 180 primary sites & 182 neck sites were examined. ROC analysis of NI-RADS 1-3 combined performance at the surgically treated primary site +/- CRT (n=82, AUC=0.495, 95% CI: 0.3160.675) vs. CRT alone (n=98, AUC=0.711, 95% CI: 0.5260.897) showed better performance for CRT alone, but no statistical significance (p=0.051). 100% of NI-RADS 3 findings at the primary site were false positives in the surgical arm versus a 50% (4/8) incidence of true disease in the CRT arm. Neck site surgery +/- CRT (n=83, AUC=0.65, 95% CI: 0.3310.969) vs. CRT alone (n=99, AUC=0.726, 95% CI: 0.4331.0) showed no statistical significance (p=0.365).

CONCLUSION

Although the diagnostic performance of NIRADS was not statistically significant different based on treatment arm, there was a trend toward better performance in patients treated with CRT versus surgery +/- CRT at the primary site due to false positives in the NI-RADS 3 category in post-surgical patients.

CLINICAL RELEVANCE/APPLICATION

NI-RADS offers a system of detecting residual HNSCC regardless of treatment type. A larger cohort study is needed to understand the best timing for PET in patients treated with primary resection.

SSA18-02 Amide Proton Transfer (APT) Imaging in Patients with Cervical Lymphadenopathy: Initial Difference between Benignity and Malignancy

Sunday, Nov. 26 10:55AM - 11:05AM Room: N229

Participants Xiaojie Luo, MD, Beijing, China (*Presenter*) Nothing to Disclose Chen Li, MMed, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Lu Yu, BS, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Min Chen, MD, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To depict practical image manifestations of magnetic resonance amide proton transfer (MR-APT) imaging in patients with cervical lymphadenopathy and to reach a profound understanding of the signal changes according to benignity and malignancy, and to discuss its potential clinical applications.

METHOD AND MATERIALS

12 patients (M = 8, average years = 56.1 ± 12.3) with cervical lymphadenopathy were enrolled in this study. They were underwent MRI on the neck. Amide Proton Transfer (APT) images (saturation time 0.8 s, saturation power 2 µT) and Diffusion Weighted Images (DWI) were included in the scanning protocols under 3.0 Tesla MR scanner. APT images were calculated using magnetization transfer ratio asymmetry at 3.5ppm with respect to water. ROIs were drawn along the contour of lymph node with maximum size on the slice consistent with chosen on DWI. APTw values of the lymph nodes in the benign group and the malignant group were compared using two-sample t-test. Pathological results of all the imaged lymph nodes were obtained through fine needle aspiration biopsy.

RESULTS

(1) Malignant lymph nodes (8/12) were metastasis from oropharynx squamous carcinoma and malignant fibrous histiocytoma. (2) MTRasym(3.5ppm) (P=0.003) were showing significant different between benignity ($1.91\% \pm 1.31\%$) and malignancy ($3.69\% \pm 0.24\%$). (3) In ROC analysis, its AUC was 0.906 and it was an effective method that the AUC was significantly different from 0.5.

CONCLUSION

APTw could be useful in differentiating benign and malignant lymph nodes.

CLINICAL RELEVANCE/APPLICATION

12 patients with cervical lymphadenopathy underwent MR-APT imaging to differentiate benign and malignant.

SSA18-03 Additive Value of Quantitative CT Texture Analysis of Lymph Nodes for Prognosis Prediction in HPV-Positive Head and Neck Cancers

Sunday, Nov. 26 11:05AM - 11:15AM Room: N229

Participants

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Hui Li, PHD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

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PURPOSE

This study aims to characterize the utility of primary tumor and lymph node texture features in predicting disease progression in patients with HPV-positive oropharyngeal squamous cell carcinoma treated with induction chemotherapy.

METHOD AND MATERIALS

Soft-tissue CT images for 35 patients with HPV-positive oropharyngeal squamous cell carcinoma were collected retrospectively under an IRB approved protocol. An experienced radiologist contoured the primary tumor and related lymph nodes in a pretreatment scan for each patient. Radiomic texture features were automatically calculated from each axial slice of the contoured volumes. Features were selected using stepwise feature selection methods in conjunction with observations from previous studies. Round robin linear discriminant analysis was used to assess feature performance, with the area under the receiver operating characteristic curve (AUC) used as a figure of merit. We investigated the comparative performances of merging RECIST with two primary tumor texture features as well as with an additional two lymph node features.

RESULTS

Based on feature selection, we chose to include the pre-treatment RECIST with tumor energy and entropy, and then with lymph node sum variance and skewness. RECIST with tumor features resulted in an AUC value of 0.64 (se = 0.12) in the task of distinguishing between cases that progressed and those that did not. The combination of RECIST, tumor, and lymph node features yielded an AUC value of 0.72 (se = 0.10).

CONCLUSION

We observed an improvement in the prediction of disease progression when the quantitative texture feature analysis of lymph nodes were included in the predictive signature as compared to a signature with just RECIST and tumor texture information. This was evidenced by an increase in AUC. This is a promising result, and we plan to perform future work to investigate this trend on a larger dataset.

CLINICAL RELEVANCE/APPLICATION

This work aims to study the utility of radiomic features of both tumor and associated lymph nodes in predicting disease progression, which subsequently can help with early diagnosis and personalized care.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Daniel Ginat, MD - 2016 Honored Educator

SSA18-04 Apparent Diffusion Coefficient Histogram and Texture Analysis of Pleomorphic Adenoma and Carcinoma ex Pleomorphic Adenoma of the Salivary Gland

Sunday, Nov. 26 11:15AM - 11:25AM Room: N229

Participants

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PURPOSE

Only subjective mean value measurement with a manual region of interest has been reported for apparent diffusion coefficient (ADC) assessment of salivary gland tumors. The purpose of this study was to investigate the usefulness of whole-tumor ADC histogram and texture analysis for differentiation between pleomorphic adenoma (PA) and carcinoma ex pleomorphic adenoma (CXPA).

METHOD AND MATERIALS

Institutional review board approval was obtained and informed consent was waived due to the retrospective nature of this study. We identified 128 patients with salivary gland tumors who underwent MR imaging and either biopsy or surgery. Patients were as follows: 116 with PA (51 men and 65 women; median age, 52.5 years; age range, 11-84) and 12 with CXPA (10 men and 2 women; mean age, 67 years; age range, 51-82). All images were obtained on the same 1.5 tesla MR scanner with a standard protocol. A blinded radiologist drew volumes of interest on the ADC map covering the entire tumor. The mean, median, minimum, maximum, percentile, standard deviation (SD), kurtosis, skewness, entropy, and uniformity of the ADC value were compared between PA and CXPA groups. A Mann-Whitney U test with false discovery rate control and a receiver operating characteristic (ROC) curve were used for statistical analysis.

RESULTS

The SD (P = 0.02) and entropy (P = 0.02) were significantly higher in CXPA. Minimum value of ADC (P = 0.02), 5th percentile ADC (P = 0.02), 10th percentile ADC (P = 0.04), and uniformity (P = 0.02) were significantly lower in CXPA. Mean ADC (P = 0.29) and Median ADC (P = 0.29) showed no significant difference. The greatest area under the ROC curve (0.785) was achieved by SD.

CONCLUSION

CXPA showed higher spatial heterogeneity (higher entropy, higher SD, and lower uniformity) of ADC and contained significantly lower value of ADC than PA.

CLINICAL RELEVANCE/APPLICATION

Whole-tumor ADC histogram and texture analysis may be useful for differentiation between PA and CXPA.

SSA18-05 Exploratory Study for Identifying Predictors for Treatment Response of Head and Neck Cancers on CT Using Computerized Analysis

Sunday, Nov. 26 11:25AM - 11:35AM Room: N229

Participants

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PURPOSE

AT-101 is an oral chemotherapeutic agent that induces apoptosis and may be beneficial in laryngeal cancer patients treated with organ preservation therapy. The objective of our study was to investigate the feasibility of using radiomic and perfusion features as predictors of tumor response to AT-101.

METHOD AND MATERIALS

Retrospective analysis of pre and post therapy CT neck scans was performed in 19 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. Post-treatment responses were obtained after one cycle of AT-101 chemotherapy from laryngoscopic exam. A positive response was recorded when there was at least 50% reduction in tumor volume. We performed a two-loop leave one out feature selection using linear discriminant analysis classifier for radiomics alone (2 features). We then took one feature from radiomic and perfusion (2 total) and built a classifier to do a leave-one-out cross-validation. Receiver operator curves and standard deviation were generated.

RESULTS

All 19 lesions examined were primary laryngeal cancers. Out of the 19 patients, there were 7 non-responders (37%) and 12 responders (63%). Selecting two radiomics features alone had an area under the curve (AUC) measuring 0.83 +/- 0.09. Out of all of the features, the best radiomic and perfusion features were the change in contrast enhancement and PS. The best radiomic and perfusion combined improved the AUC to 0.84 +/- 0.9.

CONCLUSION

Our pilot study indicates that radiomic features are good predictors of treatment response with AT-101. The combination of radiomic and perfusion minimally improved prediction. Our next step is to expand our data set with additional available patients.

CLINICAL RELEVANCE/APPLICATION

Predicting treatment response to chemotherapy is an important tool for head and neck cancer management. Good predictors can help providers choose between organ preservation and total laryngectomy.

SSA18-06 Diagnostic Performance of Simultaneous [18F] FDG PET/MR in Comparison with PET or MR Alone in Head and Neck Cancer

Sunday, Nov. 26 11:35AM - 11:45AM Room: N229

Participants

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PURPOSE

Although the benefits of PET/CT have been established in patients with head and neck malignancy, the usefulness of the recently introduced PET/MR has not been elucidated. The purpose of this study was to compare the diagnostic performance of simultaneous PET/MR with PET or MR alone in depicting malignant lesions in the head and neck.

METHOD AND MATERIALS

Seventy three patients (47 men, 26 women; mean age, 58 years; age range, 18-83 years) who underwent simultaneous PET/MR for diagnostic work-up of malignancy in head and neck were enrolled in this retrospective study. For 134 lesions (72 primary sites vs. 62 nodal levels; 79 for initial workup vs. 55 for recurrence workup) that were confirmed by pathology (n=111) and clinical follow-up (n=23), MR and PET images were retrospectively and independently reviewed, blinded to the clinical data. Subsequently, simultaneous PET/MR images were evaluated by consensus of the two readers. Area under the receiver operating characteristic curve, sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were obtained and compared among PET, MR, and simultaneous PET/MR.

RESULTS

Area under the ROC curve (AUC) of simultaneous PET/MR per lesion (0.93) and per patient (0.93) for depiction of malignancy in the head and neck were significantly higher than PET (0.85 and 0.75, respectively) or MR (0.84 and 0.80, respectively) alone (P<.05). AUC of PET/MR for initial workup (0.89) and for recurrence workup (0.99) tended to be higher than PET (0.83 and 0.85, respectively) and MR (0.81 and 0.86) (P<0.05 except for P=0.08 in comparison between PET/MR and PET for initial workup). AUC of PET/MR for primary sites (0.93) was higher than PET (0.73) and that for nodal levels (0.93) was higher than MR (0.80) (P<0.05). Thirty percent of indefinite MR ratings were placed in a definitive category (score 1 or 5) after consensus. In this series, simultaneous PET/MR had a sensitivity of 87%, a specificity of 92%, a positive predictive value of 92%, a negative predictive value

of 87%, and an accuracy of 90%.

CONCLUSION

Simultaneous PET/MR shows better diagnostic performance compared with PET or MR alone for the evaluation of malignancy in the head and neck.

CLINICAL RELEVANCE/APPLICATION

In patients with head and neck cancer, PET/MR shows better diagnostic performance compared with PET or MR alone, whether for initial or recurrence workup, or whether for primary sites or nodal levels.

SSA18-07 Intravoxel Incoherent Motion MR Imaging in the Differentiation of Benign from Malignant Sinonasal Lesions: Comparison with Conventional Diffusion-Weighted MR Imaging

Sunday, Nov. 26 11:45AM - 11:55AM Room: N229

Participants

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PURPOSE

This study aimed to evaluate intravoxel incoherent motion MR imaging (IVIM) in the differentiation between benign and malignant sinonasal lesions, and to compare the diagnostic performance of IVIM with conventional diffusion-weighted MR imaging (DWI).

METHOD AND MATERIALS

131 patients with histopathologically confirmed solid sinonasal lesions (56 benign and 75 malignant) who underwent conventional MRI, DWI, and IVIM were enrolled in this study. D, D* and f values derived from IVIM, as well as ADC value derived from conventional DWI, were measured and compared between the two groups using independent samples t-tests. The sensitivity, specificity, accuracy, positive predictive values (PPV), negative predictive values (NPV), and the area under the receiver operating characteristic (ROC) curve were determined.

RESULTS

The mean ADC and D values were significantly lower in the malignant sinonasal lesions than those in the benign sinonasal lesions (both p < 0.001). The mean f value was significantly higher in the malignant lesions than in the benign lesions (p = 0.007). The area under the curve of D value was significantly larger than that of ADC and f value (0.981 versus 0.725 and 0.641, respectively; both p < 0.001). The cutoff value of <= 0.887 for D value provided sensitivity, specificity, and accuracy of 98.7%, 96.4% and 97.7%, respectively, for differentiating benign from malignant sinonasal lesions.

CONCLUSION

IVIM appears to be a more efficient MR technique compared with conventional DWI in the differentiation between benign and malignant sinonasal lesions.

CLINICAL RELEVANCE/APPLICATION

D value from IVIM demonstrated significantly higher accuracy compared with ADC value for the differentiation of benign from malignant sinonasal lesions. Therefore, IVIM appears to be efficient MR technique for a possible method to evaluate the sinonasal lesions.

SSA18-08 Spectral Dual Energy CT Texture Analysis for the Evaluation and Characterization of Cervical Lymphadenopathy

Sunday, Nov. 26 11:55AM - 12:05PM Room: N229

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To determine whether spectral dual energy CT (DECT) texture analysis can be used to identify and differentiate metastatic nodes from head and neck squamous cell carcinoma (HNSCC), nodal involvement by lymphoma, or inflammatory nodes from normal lymph nodes.

METHOD AND MATERIALS

DECT scans of the neck from 50 patients were reviewed, 10 from each of the following groups, with multiple nodes per patient contoured for texture analysis (shown in parentheses): normal (40), inflammatory (29), lymphoma (65), HNSCC with metastatic adenopathy (31), and HNSCC with benign lymph nodes (40). For HNSCC, only patients with pathological confirmation based on lymph node dissection (positive or negative) were included. Metastatic HNSCC nodes were compared to unaffected nodes from HNSCC patients without metastatic lymphadenopathy based on neck dissection. Lymphoma and inflammatory nodes were compared to a population of normal neck scans without history of cancer or other systemic disease. Texture analysis was performed using a commercial software (TexRAD®) by manually delineating a region of interest around the largest diameter of the lymph node on VMIs ranging from 40 to 140 keV in 5 keV increments. Random forests (RF) models were constructed using various histogram-based texture features for outcome prediction with internal cross-validation in addition to use of separate randomly selected training and validation sets. Sensitivity (Sens), specificity (Spec), positive predictive value (PPV), and negative predictive value (NPV) were calculated for node classification.

RESULTS

Metastatic HNSCC nodes could be differentiated from normal nodes with a Sens, Spec, PPV, and NPV of 100%, 91%, 90%, and 100%, respectively. Sens, Spec, PPV, and NPV was 100%, 92%, 95%, and 100% for differentiating nodal involvement by lymphoma from normal nodes and 88%, 83%, 78%, and 91% for differentiating inflammatory nodes from normal nodes, respectively.

CONCLUSION

Spectral texture analysis of lymph nodes can distinguish different pathologic lymph nodes from normal nodes with a high accuracy.

CLINICAL RELEVANCE/APPLICATION

DECT texture analysis of lymph nodes may be used in radiomic models to increase accuracy for the determination and characterization of pathologic lymph nodes in the neck.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Caroline Reinhold, MD, MSc - 2013 Honored EducatorCaroline Reinhold, MD, MSc - 2014 Honored EducatorCaroline Reinhold, MD, MSc - 2017 Honored Educator

SSA18-09 Ultrasound-Guided Fine Needle Aspiration with Optional Core Needle Biopsy of Head and Neck Lymph Nodes and Masses: Comparison of Diagnostic Performance in Squamous Cell Cancer with Residual Masses after Therapy versus All Other Lesions

Sunday, Nov. 26 12:05PM - 12:15PM Room: N229

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To evaluate the diagnostic performance of ultrasound-guided fine needle aspiration (FNA) with optional core needle biopsy (CNB) of head and neck lymph nodes and masses, with attention to differences between biopsy of squamous cell carcinoma (SCC) with a residual mass after radiation or combined chemotherapy/radiation therapy and biopsy of other lesions.

METHOD AND MATERIALS

IRB approval was obtained and the need for consent was waived for this retrospective study. All 1957 ultrasound guided biopsies of head and neck lesions performed by the ultrasound service at our institution between 3/1/2012 and 5/16/2016 were reviewed. Thyroid biopsies, salivary gland biopsies, and fluid aspirations were excluded. In 843 of 861 procedures, the biopsy procedure began with an FNA and preliminary interpretation of the sample by a cytopathologist. CNB was then added in 210 cases, if considered indicated and technically feasible. In 18 cases, only CNB was performed, mostly following a recent FNA performed by another service.

RESULTS

861 biopsies of head and neck lymph nodes and masses were included; 53 targeted SCC with residual masses after treatment. The biopsy procedures yielded definitively benign or malignant results in 71.7% (38/53) of treated SCC and in 90.8% (733/807) of all other lesions (p<0.001). A reference standard based on subsequent pathology or clinical and imaging follow-up was established in 68.6% of procedures. In cases with definitive benign or malignant biopsy results and a subsequent reference standard, sensitivity for malignancy was 88.2% (95% CI, 65.7% - 96.7%) in treated SCC and 98.3% (96.0% - 99.3%) in all other cases (p=0.052) and specificity was 63.6% (35.4% - 84.8%) in treated SCC and 99.5% (97.3% - 99.9%) in all other cases (p<0.001). There were no significant complications related to the biopsy procedures.

CONCLUSION

Ultrasound-guided needle biopsy of head and neck SCC with a residual mass after therapy has significant limitations in specimen
adequacy, sensitivity and specificity. Otherwise, ultrasound-guided FNA with optional CNB of head and neck lymph nodes and masses has excellent diagnostic performance.

CLINICAL RELEVANCE/APPLICATION

Ultrasound-guided FNA with optional CNB of head/neck nodes and masses has excellent diagnostic performance, but results should be interpreted with caution in SCC with a residual mass after therapy.







SSA19

Neuroradiology (Dots and Dashes: Image Analysis in Neuroradiology)

Sunday, Nov. 26 10:45AM - 12:15PM Room: N230B

MR NR

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

FDA Discussions may include off-label uses.

Participants

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Sub-Events

SSA19-01 Enhancing the T1-weighted Template: Tissue Probability Maps and Gray Matter Labels of the IIT Human Brain Atlas

Sunday, Nov. 26 10:45AM - 10:55AM Room: N230B

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PURPOSE

The IIT Human Brain Atlas contains anatomical, DTI, HARDI templates, probabilistic gray matter (GM) labels, probabilistic connectivity-based white matter (WM) labels, and major fiber-bundles of the young adult human brain. The purpose of this work was to enhance the quality of the T1-weighted template, tissue probability maps, and GM labels of the IIT Human Brain Atlas.

METHOD AND MATERIALS

The same T1-weighted data from the 72 healthy volunteers included in the previous version of the IIT Human Brain Atlas (v.4.1) were used in the construction of the new resources. The T1-weighted image-volume of each participant was transformed from native space to the space of the existing T1-weighted template. Then, the volumes were normalized following two constraints, one for the intensity, and one for the transformation. The spatial transformations generated above were combined to a single transformation, which was then applied to the corresponding data for each participant: raw T1-weighted data, raw segmented tissue masks (GM, WM, and CSF), and raw segmented labels (90 cortical and subcortical regions). Next, the T1-weighted data from all participants were averaged to generate the new T1-weighted template. New tissue probability maps, probability maps for each label and a confidence index map for the GM labeling were also generated and compared to those of the existing atlas.

RESULTS

The new T1-weighted template is of higher sharpness (according to the high spatial frequency content), and has lower noise than the existing template. The new tissue probability maps exhibit better definition of GM, WM, and CSF than the existing ones. The new GM labels show greater confidence in GM labeling.

CONCLUSION

In this work, the T1-weighted template, tissue probability maps and GM labels of the IIT Human Brain Atlas were substantially enhanced. The IIT Human Brain Atlas with its comprehensive set of resources located in the same space, are expected to increase the accuracy of multi-modal studies, as well as conventional investigations on brain macrostructure.

CLINICAL RELEVANCE/APPLICATION

The enhanced IIT Human Brain Atlas is expected to increase the accuracy of multi-modal MRI studies.

SSA19-02 Synthetic Contrast Enhancement Map Using Post-Contrast MR Quantification Only

Sunday, Nov. 26 10:55AM - 11:05AM Room: N230B

Participants

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PURPOSE

Administration of Gadolinium contrast medium is an important diagnostic tool to detect blood-brain-barrier damage. In clinical practice the use of GD, however, is time-consuming because both a native and post-contrast image must be acquired. It is possible to omit the native image, but this reduces diagnostic confidence, especially for anatomically complex areas. For quantification of GD-enhancement image registration is challenging. The purpose of this study was to investigate the possibility to synthesize a GD-enhancement map solely from the post-GD image, using quantitative MRI.

METHOD AND MATERIALS

In brain parenchyma there is a relation between proton density PD and the longitudinal R1 relaxation rate. For every 1% decrease of PD signal, the R1 increases with 0.03 s-1 (3T). This relation is affected when GD contrast media is present in the tissue, since R1 increases, while PD remain the same. A simultaneous measurement of post-GD PD and R1 therefore provides means of calculating the difference in R1 due to GD compared to the expected native R1 based on the PD values. For 10 patients with malignant glioma grade 4, MR quantification was performed both before and after contrast administration. The acquisition was a MAGiC sequence on a GE 750 3T system with a scan time of 6 minutes. Post-processing was performed using SyMRI 8.0 (SyntheticMR, Sweden). The two image stacks were registered using in-plane transformation. The R1 maps were subtracted to obtain the true GD-enhancement map. This was correlated with the synthetic GD-enhancement map, created using the post-GD R1 and PD maps only.

RESULTS

Linear regression of the true and synthetic GD-enhancement map for the 10 subjects showed a mean slope of 1.15 ± 0.21 and mean intercept of 0.02 ± 0.14 . The Pearson correlation coefficient was 0.856 ± 0.05 .

CONCLUSION

The study shows that it is possible to synthesize a GD-enhancement map based on a post-GD MR quantification sequence only.

CLINICAL RELEVANCE/APPLICATION

A GD-enhancement map based on a post-GD acquisition only may permit omission of a native T1W, resulting in a substantial time saving. Without time pressure for GD uptake, it may even lead to lower GD doses.

SSA19-03 Correlation of Quantitative Analysis on Three-Dimensional Fluid-Attenuated Inversion Recovery (3D-FLAIR) and Contrast-Enhanced FLAIR with Auditory Test in Meniere's Disease

Sunday, Nov. 26 11:05AM - 11:15AM Room: N230B

Participants

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PURPOSE

This study was aimed to assess the prognostic value of quantitative analyses of cochlear signal intensity(SI) using Three-Dimensional Fluid-Attenuated Inversion Recovery (3D-FLAIR) MRI and Contrast-Enhanced (CE)- FLAIR MRI, and designed to correlate cochlear ROI with degree of hearing decrease in patients with Meniere's disease.

METHOD AND MATERIALS

132 patients underwent 3 Tesla (3T) MRI of the temporal area for MD over 3-year period. 3D-FLAIR sequence imaging and CE-FLAIR were included on temporal MRI. Signal intensity was measured by drawing region of interest (ROI) in membranous labyrinth of cochlea and quantitatively analyzed. Measured cochlear signal intensity was compared with available clinical findings, speech audiometry and pure tone audiometry test (PTA). Patients had typical results of auditory testing for Meniere's disease.

RESULTS

There was statistical significance of patient's sex with 3D-FLAIR (p < .05) and CE-FLAIR (p < .01). Cochlear ROI in symptomatic ear side showed significant statistical significance on both FLAIR and enhanced FLAIR (p < .0001). There was statistical significance of increase of cochlear SI on 3D-FLAIR and CE-FLAIR with pretreatment PTA of hearing loss (P < .0001). There was no statistical significance of prognosis and cochlear SI of FLAIR and CE-FLAIR. There was no statistical significance of PTA change with contrast enhancement index and contrast enhancement ratio. The optimal cut off value of SI increase on FLAIR was 20.8 (sensitivity, 64%; specificity, 66%; AUC, 72.9) and on enhanced FLAIR was 30.4 (sensitivity, 66%; specificity, 68%; AUC, 72.8) between asymptomatic ear and symptomatic ear.

CONCLUSION

Quantitative analysis of ROI on MR imaging data does not confer a benefit to predict the prognosis of Meniere's disease. However, increased signal intensity and inner ear enhancement of 3D FLAIR are helpful diagnostic markers for Meniere's disease.

CLINICAL RELEVANCE/APPLICATION

Increased cochlear ROI on 3D-FLAIR and enhanced FLAIR MRI provide an ideal diagnostic evidences in the sudden sensory neural hearing loss patients.

SSA19-05 Can MR Textural Analysis Improve Detection of Extracapsular Nodal Spread in Patients with Oral Cavity Cancer: A Feasibility Study

Sunday, Nov. 26 11:25AM - 11:35AM Room: N230B

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To explore the utility of MR texture analysis (MRTA) for detection of extracapsular nodal spread (ECS) in oral cavity squamous cell carcinoma (SCC).

METHOD AND MATERIALS

30 patients with node-positive oral cavity SCC treated surgically in a single center were evaluated. 15/30 (50%) had pathologic evidence of ECS. 2 experienced radiologists independently reviewed baseline MRI blinded to histology. Presence/absence of MR features associated with ECS (flare sign, irregular capsular contour; local infiltration; nodal necrosis) were agreed in consensus. Regions of interest (ROI) encompassing largest nodal cross-sectional area were defined on T2 and post-contrast T1-weighted images. First-order texture parameters (entropy, skewness and kurtosis) were extracted from the ROIs using proprietary software (TexRAD) with fine (2mm), medium (4 mm) and coarse (6 mm) filters. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of MR predictors of ECS were compared with histology as gold standard. MRTA performance in predicting ECS was assessed using paired t-test. Areas under the curve (AUC) calculated by receiver operating characteristics (ROC) analysis and optimal threshold were calculated for texture parameters.

RESULTS

Sensitivity, specificity, PPV and NPV (%) for MR predictors were: flare sign 85.7, 93.3, 85.7, 93.3; irregular capsular contour 53.3, 86.7, 80, 65; local infiltration 26.7, 86.7, 66.7, 54.2; nodal necrosis 73.3, 46.7, 57.9, 63.6. Nodal entropy had a statistically significant correlation with ECS on T2 imaging independent of filtration level, highest with coarse nodal entropy (N6, p = 0.02). AUC for entropy N6 was 0.77, sensitivity 73.3%, specificity 80%, PPV 76.7%, NPV 73.3% with a threshold > 6.12.

CONCLUSION

First-order texture parameters (entropy) extracted from T2-weighted MRI may improve ECS prediction in oral cavity SCC.

CLINICAL RELEVANCE/APPLICATION

Extracapsular nodal spread (ECS) is associated with adverse prognosis in oral cavity squamous cell carcinoma and may alter planned treatment. MR texture analysis may increase pre-treatment detection of ECS but requires further validation.

SSA19-06 Multiresolution Texture Processing of T2-weighted MRI May Reveal Lesion Pathology in Multiple Sclerosis

Sunday, Nov. 26 11:35AM - 11:45AM Room: N230B

Participants

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PURPOSE

Focal lesions remain the hallmark pathology of multiple sclerosis (MS), however, MRI lesion burden correlates only modestly to patient disability due to the lack of lesion specificity. We hypothesize that advanced image post-processing techniques can help extract latent lesion pathology from standard MR images.

METHOD AND MATERIALS

1.5:T T2-weighted MR images acquired from 5 postmortem multiple sclerosis patients were post-processed using advanced texture analysis. Histologically proven lesion types were examined by severity: active or chronic active (demyelinated with variable inflammation), versus pre-active (inflammation only) or shadow plaques. A total of 13 lesions and 20 controls were used in a classification experiment, with a subsample of the ventricles included for comparison. Using the polar Stockwell transform, we generated two spectral density maps for each of the 10x256x256 pixels in the data set: one radial and one angular. Borrowing from the chemometrics literature, we used principal component analysis to estimate the dominant textures in the dataset. Anatomical features, control white matter, and MS lesions were hypothesized to be realizations of these textures. Using quadratic discrimination analysis, we categorized regions of interest based on 7 of these dominant textures (99.9% of variance).

RESULTS

Our results indicate that different lesion subtypes show distinct MRI texture (Fig.:1), which also differs from the surrounding tissue. Overall, our method was 88% accurate (212/240) in classifying the pathological severity of tissue types.

CONCLUSION

This pilot study suggests that novel image analysis techniques have the potential to detect the type of lesion pathology concealed in clinical MRI. Lesions with both demyelination and inflammation showed different texture than lesions with either pathology alone.

CLINICAL RELEVANCE/APPLICATION

This new technique can be applied to patient images routinely collected in clinical practice, and has the potential to advance our ability to monitor disease progression and treatment response.

SSA19-07 Radiomics Features of MR Imaging as Prognostic Factors in Locally Advanced Head and Neck Squamous Cell Carcinoma

Sunday, Nov. 26 11:45AM - 11:55AM Room: N230B

Participants

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PURPOSE

Radiomics refers to the comprehensive quantification of tumor phenotypes by applying a large number of quantitative image features. The current study was to identify pre-treatment T2-weighted imaging (T2WI)-based radiomics as prognostic factors in patients with locally advanced head and neck squamous cell carcinoma (HNSCC).

METHOD AND MATERIALS

This study consisted of 119 patients with stage III- IVb HNSCC. A total of 485 radiomics features were extracted. Least absolute shrinkage and selection operator (LASSO) regression model was used for data dimension reduction and feature selection. Association between the radiomics signature and overall survival (OS) was explored. Further validation of the radiomics signature as an independent biomarker was performed by using multivariate Cox regression. Multivariate models were built for overall survival (OS) using only clinical factors, and combined clinical factors and pretreatment radiomics signature. To quantify the incremental value of the radiomics signature to the traditional staging system and other clinical factors, Harrell's C-index was measured.

RESULTS

Clinical factors of sex and AJCC stage were statistically associated with OS of patients, respectively. The radiomics signature, which consisted of 7 selected features, was significantly associated with OS, independent of clinical risk factors (P<0.001). Incorporating the radiomics signature with sex and stage resulted in better performance (C-index: 0.70; 95% confidence interval [CI]: 0.63, 0.76) for the prediction of OS than using sex and stage alone (C-index: 0.63; 95% CI: 0.54, 0.73) (P=0.003).

CONCLUSION

The radiomics signature is an independent biomarker for OS estimation of patients with locally advanced HNSCC. Combination of the radiomics signature with clinical factors significantly improves the predictive performance of clinical factors alone.

CLINICAL RELEVANCE/APPLICATION

The current study was to explore the potential of pre-treatment T2-weighted imaging (T2WI)-based radiomics as prognostic factors in patients with locally advanced head and neck squamous cell carcinoma (HNSCC). A 7-feature-radiomics signature was developed proved to be an independent biomarker for OS estimation of patients with locally advanced HNSCC. Combination of the radiomics signature with clinical factors significantly improves the predictive performance of clinical factors alone.

SSA19-08 Fusion MR Imaging: A Fast One Stop Shopping Tool for Diagnosis and Characterization of Vestibular and Intralabyrinthine Schwannomas

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Sunday, Nov. 26 11:55AM - 12:05PM Room: N230B
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Participants

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PURPOSE

To prove the technical feasibility of fusing heavily T2-weighted 3D turbo spin-echo (SPACE) and contrast-enhanced T1-weighted 3D (MPRAGE) datasets and to determine reading time to final diagnosis and diagnostic accuracy in patients with suspected

vestibular or intralabyrinthine schwannomas.

METHOD AND MATERIALS

53 patients were evaluated. Two radiologists specialized in ENT with 10 and 14 years of experience evaluated 3D T2 and post Gd T1 images and fusion sequences in consensus as the reference standard. For the evaluation of reading time and diagnostic accuracy two groups of two less experienced radiologists (residents in 3rd-4th year of training) were formed. Group 1 evaluated 3D T2 and Gd T1 images seperately, group 2 read the fused images only. Image quality was assessed based on a 5-point-scale (1 = highest confidence to 5 = diagnosis not possible). Interobserver agreement was calculated using Cohen's kappa.

RESULTS

Fused images yielded significantly faster reading times (39.5 ± 28.5 s vs. 67.5 ± 34.5 s; p <= 0.001) compared to conventional separate reading of both 3D T2 and T1 sequences in all cases. Image quality of fused images was rated significantly better by all readers (p <= 0.05) with higher diagnostic accuracy (fusion images: sensitivity 100%; specifity 90-100% vs. conventional group: sensitivity 100%; specifity 88-94%). Interobserver agreement according to recognized lesion was excellent (0.87-1.0).

CONCLUSION

Fused images of high-resolution 3D heavily T2-weighted and contrast-enhanced T1-weighted images allow for faster detection and more precise characterization of vestibular and intralabyrinthine schwannomas.

CLINICAL RELEVANCE/APPLICATION

The possibility of displaying the fluid-filled architecture of the cerebellopontine angle and the inner ear by 3D T2-weighted MR imaging combined with contrast enhanced T1-weighted MPRAGE is helpful to improve radiologist workflow and increase diagnostic accuracy and efficiency to detect even small targets that are difficult to delineate especially in the inner ear in usual examination.

SSA19-09 CT Imaging of Periocular Metallic Foreign Bodies Can be Improved by Artifact Reduction Software

Sunday, Nov. 26 12:05PM - 12:15PM Room: N230B

Participants Mike Sheng, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose Keiman Willett, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose John H. Woo, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Computed tomography (CT) is the standard of care for the assessment of ocular and orbital trauma, however, streak artifacts due to retained metallic foreign bodies (FB) can limit the utility of CT. We hypothesize that implementation of metal artifact reduction techniques could improve image quality and diagnostic confidence for a diverse group of interpreters regardless of experience or specialty.

METHOD AND MATERIALS

Ten cases of retained periocular metallic foreign bodies which were noted on CT scan were identified retrospectively from a large urban trauma center. Post-acquisition images were processed with metal streak artifact reduction (MAR) software. The change in the severity of the metal streak artifact was assessed quantitatively by 1) the size of the artifact and 2) the standard deviation of pixel intensities along a path surrounding the foreign body. For subjective assessment, radiologists (4), ophthalmologists (4) and oculoplastic specialists (3) used a Likert scale to grade images on 6 different clinically relevant criteria.

RESULTS

The standard deviation of pixel intensity for a path surrounding the FB as well as the area of the streak artifact was decreased in all cases (p<0.001, paired t-test). Human grading of overall confidence in diagnosis and severity of metallic streak was improved with MAR (p<0.001, Wilcoxon signed-rank test). Similarly, the confidence of assessment of specific structures - including identification of FB, extra-ocular muscles, optic nerve, ruptured globe and orbital fracture -- was improved after MAR (p<0.001, Wilcoxon signed-rank test) but to various degrees in each case.

CONCLUSION

Postprocessing metal artifact reduction algorithms in computed tomography of the orbit can improve image quality by decreasing streak artifact as well as increase interpreter confidence in assessing vital anatomical structures in cases of orbital trauma.

CLINICAL RELEVANCE/APPLICATION

Metal artifact reduction algorithms in computed tomography has potential benefits in improving diagnostic accuracy and confidence in periocular trauma cases.





103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA20

Physics (CT: Photon Counting and Spectral CT)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S403B

СТ РН

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

FDA Discussions may include off-label uses.

Participants

Katsuyuki Taguchi, PhD, Baltimore, MD (*Moderator*) Research Grant, Siemens AG; Consultant, JOB Corporation Guang-Hong Chen, PhD, Madison, WI (*Moderator*) Research funded, General Electric Company Research funded, Siemens AG

Sub-Events

SSA20-01 Multi-Material Decomposition of Iodine Mixed with Potential High-Z Contrast Agents in Energy Discriminating Photon Counting Computed Tomography

Sunday, Nov. 26 10:45AM - 10:55AM Room: S403B

Participants

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PURPOSE

To evaluate the quality of a quantitative image-based multi-material decomposition algorithm on mixtures of potential CT contrast agents (CA) for Photon Counting Detector CT (PCD-CT) technology.

METHOD AND MATERIALS

CT-images were obtained using a PCD-CT research scanner (SOMATOM CounT, Siemens Healthcare GmbH, Forchheim). Three tube voltages were applied: 100, 120, and 140 kV using 160, 120, and 80 mAs, respectively. All CT images were acquired using four energy thresholds: 25, 45, 65, and 80 keV. Three mixtures of aqueous solutions of iodine and a high-Z CA, either Gadolinium (Gd), Hafnium (Hf) or Tungsten (W), were investigated. They were placed into vials arranged around the center of a cylindrical 20 cm wide water-equivalent phantom. Both a two and a three material decomposition, including water as a third base material, were applied to the reconstructed energy threshold images. Identical measurements were repeated 15 times to determine average concentrations and the systematic deviation. The statistical errors were assessed by the evaluation of the dose normalized standard deviations of the measured concentrations.

RESULTS

When decomposing into two base materials the measured concentrations deviated from the known values from -0.5 mg/mL to 0.5 mg/mL. The overall best performance was observed for the differentiation of I and Hf using the 140 kV x-ray spectrum and the given energy thresholds (0.1 mg/mL and 0.0 mg/mL deviation for I and Hf, respectively). By adding water as a third base material, the systematic deviations increased to a range from -2.7 mg/mL to 1.8 mg/mL. Separation into I, water and either Gd or Hf provided more accurate results due to their better energy separation when compared to I, water and W, where especially water and W showed similar attenuation over all selected energies.

CONCLUSION

For the selected x-ray spectra and energy thresholds, the two-material decompositions provided good results with absolute deviations from the known concentrations under 0.5 mg/mL. By adding water as a third base material the accuracy of the decomposition decreased, especially with tungsten at 100 kV due to its similar spectral characteristics to water at this configuration.

CLINICAL RELEVANCE/APPLICATION

To separate and quantify mixed CA solutions using image data from a single PCD-CT scan

SSA20-02 Differentiation between Blood and Iodine in a Bovine Brain: Initial Experience with Spectral Photon-Counting CT

Sunday, Nov. 26 10:55AM - 11:05AM Room: S403B

Isabelle Riederer, MD, Munich, Germany (*Presenter*) Nothing to Disclose Daniel Bar-Ness, Bron, France (*Abstract Co-Author*) Nothing to Disclose Franz Pfeiffer, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose Philippe C. Douek, MD, PhD, Lyon, France (*Abstract Co-Author*) Nothing to Disclose Peter B. Noel, PhD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose Daniela Muenzel, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose Sebastian Ehn, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose Salim Si-Mohamed, Lyon, France (*Abstract Co-Author*) Nothing to Disclose Alexander A. Fingerle, MD, Munchen, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the potential of the Spectral Photon-Counting CT (SPCCT) for the differentiation between blood and iodine in a bovine brain.

METHOD AND MATERIALS

First, in vitro experiment using tubes with blood and different concentrations of iodine-based contrast material were scanned with a preclinical SPCCT system to obtain spectral and conventional data. Second, tubes with (a) blood and (b) iodine-based contrast material were positioned within a bovine brain. Iodine maps and virtual non-contrast images were generated using the multibin spectral information to perform material decomposition. Region of interest (ROI) analysis were performed within the tubes to quantitatively determine the absolute content of iodine.

RESULTS

In the conventional CT images, ROI analysis showed similar HU density values for the tube with blood and iodine (59.9 + - 1.8 versus 59.2. + - 1.5). Iodine maps enabled clear differentiation between blood and iodine in vitro as well as in the bovine brain. Quantitative measurements of the tubes with different iodine concentrations matched well with those of actual prepared mixtures.

CONCLUSION

Spectral Photon-Counting CT enables differentiation between blood and iodine in vitro and within a bovine brain, and quantification of different iodine concentrations is feasible.

CLINICAL RELEVANCE/APPLICATION

Spectral Photon-Counting CT providing iodine maps and virtual non-contrast images allows for material decomposition and reliable quantification of different iodine concentrations.

SSA20-03 Gold Nanoparticle-Based Contrast-Enhanced CT in a Large Animal Model of Renal Artery Stenosis Using a Whole Body Photon-Counting CT System

Sunday, Nov. 26 11:05AM - 11:15AM Room: S403B

Participants

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PURPOSE

To evaluate, in phantoms and in a swine model of renal artery stenosis (RAS), the performance of a photon-counting CT (PCCT) system for quantification of targeted-gold nanoparticles (AuNPs).

METHOD AND MATERIALS

We used a whole-body PCCT system (Siemens Healthcare, Germany) to image phantoms and a swine with induced RAS. AuNPs (bare size = 20 nm) were synthesized using gold chloride solution (10% HAuCl4.3H20) and 5% sodium citrate dihydrate. Collagen-1 antibody conjugated PEG-coated AuNPs (45 nm) were made to target tissue fibrosis. RAS was induced in a pig by placing a local-irritant coil in the main renal artery for 6 weeks. A 20 cm water phantom with iodine (4, 8, 10 mg/mL) and AuNPs (2, 4, 6 mg/mL) solutions was scanned to assess material quantification accuracy. Renal artery angiography of the pig was performed to assess the degree of stenosis using iodinated contrast (Omnipaque, GE Healthcare Inc.), followed by PCCT scans (T = 0: no AuNPs, and T=1: 20 mL intra-renal injection of 20mg/mL AuNPs). All scans were performed at 120 kVp, 550mAs (CTDIvol = 47.8 mGy) with energy thresholds 25, 48, 65 and 75 keV. Images were reconstructed using filtered backprojection and a quantitative, medium-smooth kernel (D30). Prototype software (eXamine, Siemens Healthcare, Germany) was used for material quantification of targeted-AuNPs and residual iodine from renal angiography.

RESULTS

Regression analysis revealed a close linear relationship (R2 =0.95) between the measured and true AuNP densities in the phantom. AuNPs at 2, 4 and 6 mg/mL were estimated at 2.2, 3.5 and 6.3 mg/mL respectively. In the swine images, ROI analysis showed a CT number enhancement of approximately 76 HU within the injected stenotic kidney cortex and medulla, while a circular ROI in the paraspinal muscle showed a mean CT number of 60 HU.

CONCLUSION

We evaluated the performance of PCCT and material quantification for multi-contrast imaging, specifically, measuring CT number enhancement induced by low concentrations of AuNPs. We have demonstrated for the first time in vivo imaging of AuNPs in a large animal model using a whole-body PCCT system, albeit the signal magnitude at the current level of development is challenging.

CLINICAL RELEVANCE/APPLICATION

Gold nanoparticles can be tailored for molecular imaging, targeting certain tissue-types and organs thereby enabling novel applications of PCCT in diagnosis and treatment assessment.

SSA20-04 Spectral Ultra-High Resolution Coronary Stent Imaging with Photon-Counting CT: Initial Experience

Sunday, Nov. 26 11:15AM - 11:25AM Room: S403B

Participants

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PURPOSE

To evaluate the performance of an ultra-high resolution (UHR) spectral photon-counting detector (PCD) computed tomography (CT) system for coronary stent imaging and to compare the results to conventional energy-integrating detector (EID) CT.

METHOD AND MATERIALS

Coronary stents with different diameters (2.0-4.0 mm) were examined inside a coronary artery phantom consisting of plastic tubes filled with iodine-based contrast material diluted to approximate clinical concentrations (450 HU). EID images were acquired using 2nd and 3rd generation dual-source CT systems (SOMATOM Flash and SOMATOM Force, Siemens Healthcare) at 0.60 mm isotropic voxel size. Radiation-dose matched PCD images were acquired using a prototype ultra-high resolution PCD system (Siemens Healthcare) at standard 0.50 mm and ultra-high 0.25 mm isotropic resolution. Images were reconstructed using optimized convolution kernels. Image quality of EID versus PCD for stent diameter visualization was compared using one-way analysis of variance and Wilcoxon signed-rank test. Paired t-test was used to compare the accuracy of spectral PCD iodine quantification in the presence or absence of the highly attenuating stents.

RESULTS

UHR PCD images significantly improved stent lumen visualization (78.2 \pm 9.6%) over EID Flash, EID Force, and standard resolution PCD images (52.5 \pm 12.6%, 56.8 \pm 12.5%, and 60.3 \pm 12.3%, respectively, all P<0.01). Stent lumen visualization improved with larger stent sizes for all image series (P<0.05 Pearson correlation). Spectral PCD iodine imaging enabled visualization of the coronary artery lumen without interference from the coronary stent or plastic tube. PCD iodine quantification was similar in the presence or absence of the coronary stents (23.0 \pm 1.7 mM vs 22.9 \pm 0.9 mM, P=0.81), suggesting robustness of material decomposition to beam hardening artifacts.

CONCLUSION

Ultra-high resolution PCD CT may significantly improve coronary stent lumen visualization over conventional CT due to reduced blooming artifacts with the added advantage of providing spectral information that may be used for material decomposition.

CLINICAL RELEVANCE/APPLICATION

Improved coronary stent lumen visualization with ultra-high resolution PCD CT may allow for improved non-invasive diagnosis of stent malapposition and in-stent restenosis.

SSA20-05 Image based Material Decomposition with Material Map De-noising using Photon Counting Computed Tomography (PCCT)

Sunday, Nov. 26 11:25AM - 11:35AM Room: S403B

Participants

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To develop and validate a new image based material decomposition method using non-local means (NLM) and alternating direction method of multipliers (ADMM).

METHOD AND MATERIALS

Image based material decomposition was formulated as minimization of an objective function consisting of a data fidelity and a NLM-based regularization term. The optimization problem was solved with ADMM. The method was evaluated using simulations, phantom and animal studies. Vials containing various concentrations of iron chloride and sodium chloride solutions were used in simulations. For phantom studies, vials containing calcium chloride and iohexol solutions were placed in a 20 cm water phantom and scanned on a whole-body PCCT scanner (CounT, Siemens Healthcare). Material decomposition was performed using denoised images and results were compared to the reference concentrations. In addition, a female swine was scanned on the PCCT scanner with 140 kV, 4 energy thresholds (25, 45, 65, 85 keV), 140mAs, 32x0.5 mm collimation and 15.5 mGy CTDIvol (matched to clinical dose level). Performance of the proposed method was compared to a least squares (LS) based decomposition method using original and denoised images.

RESULTS

A linear relationship was observed between measured and reference concentrations ($R2 \ge 0.93$) using the proposed method. Compared to the LS method (with and without denoising), it showed more uniform appearance and less noise in all three studies. In simulations, the proposed method had 90, 91, and 91% reduction of root mean square errors (RMSE) in the Fe, Na and water concentration measurements compared to the LS method, and 27, 31 and 29% reduction compared to the LS method with denoising. In the phantom study, the RMSE in the Ca, I and water concentrations were reduced by 90, 89 and 78%, and 17, 14, and 4% of LS without and with denoising, respectively.

CONCLUSION

Simulation and phantom studies quantitatively demonstrated that the proposed method provided accurate material specific images with low image noise. The advantage of the proposed method was further confirmed in the in-vivo swine study, where the patchy appearance of LS method with denoising in the material specific images was decreased with proposed method.

CLINICAL RELEVANCE/APPLICATION

The proposed method provides accurate and low noise material specific images using PCCT multi-energy imaging at clinical dose levels.

SSA20-06 Efficient and Accurate Spectral Distortion Compensation for Photon Counting CT via Low-Rank Approximation-Based X-Ray Transmittance Modeling

Sunday, Nov. 26 11:35AM - 11:45AM Room: S403B

Participants

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PURPOSE

Photon counting detectors (PCDs) provide spectral sensitivity with energy windows; however, the measured spectrum is distorted due to charge sharing and fluorescent x-ray emission. These spectral distortions can be compensated for to improve material decomposition accuracy. Thus, the aim of this study was to develop a method that is more computationally efficient than maximum likelihood (ML) estimator, while it is also as accurate and precise as ML is.

METHOD AND MATERIALS

We have developed a method that works on each of sinogram point independently and efficiently. The spectral distortion model was incorporated as the imaging chain, which related the incident x-ray spectrum to the attenuation due to the object (which is called "x-ray transmittance") to the output of PCD. The non-linear x-ray transmittance was modeled by a set of energy-dependent basis curves via the low-rank approximation, and the coefficients of the basis curves, which were linearly related to the PCD output, were efficiently estimated by solving the linear minimization problem. Thorough and systematic computer simulations were performed to assess the performance of the proposed method.

RESULTS

We have performed two types of computer simulations with two objects. The first object consisted of soft tissue and bone, whereas the second object added gadolinium to the first object. Many combinations of different thicknesses of multiple materials were examined. The computational efficiency of the proposed method was found to be orders of magnitude faster than ML with non-negativity constraint (ML+) (0.22 min versus 1,056.8 min). The bias of the proposed method was smaller than the ML and ML+. The noise of the proposed method was comparable to Cramer Rao lower bound (CRLB) and slightly larger than that of ML+. The reconstructed K-edge images showed streaking artifacts due to the bias with ML+, whereas accurate results with the proposed method.

CONCLUSION

We have developed a method, which is computationally efficient, can compensate for the spectral distortion more effectively than ML or ML+, and has noise level that is comparable to CRLB.

CLINICAL RELEVANCE/APPLICATION

Efficient and effective spectral distortion compensation is the key to the direct characterization of tissues and lesions, which is expected to be an important feature of PCD-CT.

SSA20-07 First Evaluation of New Photon Counting Technology for Cardiac CT

Sunday, Nov. 26 11:45AM - 11:55AM Room: S403B

Participants

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PURPOSE

We are developing a novel photon-counting detector with 8 energy bins and 0.2x0.3mm^2 pixels at the isocentre for highresolution clinical computed tomography (CT) imaging. We present the first images of excised human hearts that were scanned using our detector technology, showing improved visibility of arterial plaque and iodine compared to the current state of the art. In addition, we demonstrate the feasibility of projection-based, three-material basis decomposition for cardiac CT based on measurements acquired with the new detector technology.

METHOD AND MATERIALS

Post-mortem human hearts from five individuals were staged and imaged using a spectrally resolved photon counting detector made of crystalline Silicon. The hearts were sliced axially and then mounted in a 3D-printed model to preserve the anatomical structure and facilitate imaging despite different scanning orientations. Coronary arteries that were cut were closed with 6-0 sutures and the lumen filled with gelatine containing iodine to obtain relevant Hounsfield Unit contrast. Reconstructed CT images from the photon counting system were compared to those acquired using three state-of-the-art clinical CT scanners at the Karolinska University Hospital. We compared the visibility and separation of arterial plaque and iodine. In addition, we performed projection-based three-material basis material decomposition using recent developments in forward-model calibration - not currently possible with dual-energy clinical CT systems.

RESULTS

The results demonstrate improved spatial and spectral resolution, compared to state-of-the-art. Specifically, we demonstrate increased visibility and separation of arterial plaque and iodine. In addition, unbiased iodine basis material images are presented.

CONCLUSION

Several excised human hearts have successfully been imaged using a novel photon-counting spectrally resolved detector with submillimetre spatial resolution. Compared to current state of the art, reconstructed CT images demonstrate improved spatial and spectral resolution, which may improve CT applications such as cardiac imaging.

CLINICAL RELEVANCE/APPLICATION

High-resolution CT with enhanced spectral capability may benefit cardiac imaging by improving quantitation in calcium scoring due to reduction of blooming artefacts, visualization in coronary CT angiography, and perfusion analysis due to improved detection of iodine and unbiased material-specific imaging.

SSA20-08 Anisotropic Denoising for Material Decomposition from Spectral Photon-Counting CT: Application to Human Blood Iron Level Estimation

Sunday, Nov. 26 11:55AM - 12:05PM Room: S403B

Awards

Trainee Research Prize - Fellow

Participants

Adam P. Harrison, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose Rolf Symons, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose Daniel J. Mollura, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose David A. Bluemke, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Research agreement, Siemens AG; Research support, Siemens AG; Research agreement, Carestream Health, Inc; Research support, Carestream Health, Inc Amir Pourmorteza, PhD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To develop a radiation dose-efficient image-based material decomposition technique for spectral photon-counting CT (PCCT) data and to investigate estimating human blood iron concentration from contrast-enhanced (CE) scans.

METHOD AND MATERIALS

We adapt the well-known anisotropic denoising (AD) approach for simultaneous denoising and decomposition of spectral PCCT images. Unlike the standard pixel-by-pixel approach, AD regularizes the solution using similarity weights between neighboring pixels.

We tailor AD for PCCT in two ways. First, to ensure accuracy, we employ a *guided* similarity calculation, using the image created from all detected photons, regardless of their spectral bin, to calculate weights. We assume the all-photon image contains all the edge information of the spectral bins but is less noisy. Second, we incorporate the linear generative model directly into the anisotropic equation, simultaneously estimating concentration maps of all pixels from spectral bins. AD only requires a large and sparse linear system to solve, with one parameter for the filter weight.

RESULTS

We test AD on 4-energy threshold spectral PCCT scans of a human subject pre- and post-contrast. The decomposition method was calibrated using vials of known concentrations of iodine and Fe solutions placed under the patient. The vials were also used to calculate the precision and bias of AD. The blood iron content of the CE scan was estimated and compared to that of the pre-contrast scan. Within the vials, AD estimates remain stable while reducing noise SD by 56% and 54% for iron and iodine, respectively. This suggests over 4x decrease in radiation. Aortic iron concentration measured from AD had small bias, but with a noise reduction of 67.8%. The small bias (-5%) in CE Fe content may be attributed to the blood volume increase after injection.

CONCLUSION

The dose-efficient AD decomposition method shows improved precision over the standard approach in estimating blood-iron concentration. Future work will include additional human studies to determine the optimal tradeoff between precision and algorithmic bias.

CLINICAL RELEVANCE/APPLICATION

This algorithm can provide higher quality concentration maps from spectral photon-counting CT, improving estimation of blood-iron content in addition to iodine concentration.

SSA20-09 Applied Quantitative Multi-Material Decomposition Using Photon Counting Detector CT (PDC-CT) Image Data

Sunday, Nov. 26 12:05PM - 12:15PM Room: S403B

Participants

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PURPOSE

To apply and evaluate an image based decomposition algorithm on three and four materials using single scan multi-energy projection data acquired by a research photon counting detector CT (PCD-CT) system.

METHOD AND MATERIALS

Six solutions of contrast agents (CAs) in concentrations of 5 and 10 mg/mL were investigated: zirconium (Zr), iodine (I), gadolinium (Gd), dysprosium (Dy), hafnium (Hf), and tungsten (W). The K-edges of all materials lay in the energy range for clinical CT. Multienergy CT-images were obtained from eight different combinations of sets of three CAs. The solutions, each filled into a 2 cm wide vial, were arranged in an equiangular fashion inside a 20 cm diameter water-equivalent phantom. All CT-images were acquired using a PCD-CT research system (SOMATOM CounT, Siemens Healthcare GmbH, Forchheim) with tube voltages of 100, 120, or 140 kV and respective tube current-time-products of 160, 120, 80 mAs. Four energy thresholds were applied: 25, 45, 65, and 80 keV. The reconstructed energy-threshold images were decomposed into concentration images of three or four materials. For the first case, the respective materials of the investigated set of CAs were chosen as base materials, for the second case, water was additionally included as a base material. The resulting accuracies were determined by comparing the extracted concentration values to the corresponding known values.

RESULTS

The CAs could be differentiated and quantified in all investigated cases. The mean deviations of the measured concentrations were 8% for 100 kV, 3% for 120 kV, and 9% for 140 kV. The two different concentrations provided linear proportionality in CT-values. CAs with similar x-ray attenuation characteristics showed resembling enhancements throughout the single spectral images and showed greater deviations from the anticipated concentration values (up to -34% for separation of I, Hf, W, and water at 120 kV).

CONCLUSION

An image-based multi-material decomposition algorithm was applied on CT-data of a PCD-CT research system. The measured concentrations of different CAs showed good correspondence to their known concentrations. The quality of the material separations depend on the selected base materials, the number of base materials, the applied x-ray tube voltage and the selected energy thresholds.

CLINICAL RELEVANCE/APPLICATION

To demonstrate feasibility of applying and separating multiple contrast agents within a single PCD-CT scan.



KSNA° 2017

103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA21

Physics (CT: New Techniques)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S404AB

СТ РН

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

FDA Discussions may include off-label uses.

Participants

Cynthia H. McCollough, PhD, Rochester, MN (*Moderator*) Research Grant, Siemens AG Ke Li, PhD, Madison, WI (*Moderator*) Nothing to Disclose

Sub-Events

SSA21-01 Potential Application of Photon Counting Detector CT in Intracranial Hemorrhage Detection

Sunday, Nov. 26 10:45AM - 10:55AM Room: S404AB

Awards

Trainee Research Prize - Medical Student

Participants

Xu Ji, Madison, WI (*Presenter*) Nothing to Disclose Yongshuai Ge, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Ran Zhang, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Guang-Hong Chen, PhD, Madison, WI (*Abstract Co-Author*) Research funded, General Electric Company Research funded, Siemens AG

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PURPOSE

Detection and monitoring of intracranial hemorrhage (ICH) is crucial for the management and treatment of acute strokes. When endovascular stroke therapy is performed in the angiography suite, there is often a need for intraoperative ICH imaging, which currently is performed using C-arm CBCT with a flat panel detector (FPD). However, the performance of CBCT for detecting low contrast ICH may be severely limited. The purpose of this work was to study the potential of a photon counting detector (PCD)based CT system for reliable ICH imaging.

METHOD AND MATERIALS

The PCD-CT system used a CdTe-based PCD with 100 µm pixel size, 50 cm transverse coverage, 150 fps maximal readout speed, >75% MTF@ 2 lp/mm, >50% DQE(f) @2 lp/mm, and negligible lag. Other major components of the PCD-CT include a rotating-anode diagnostic tube, 0.2 mm Cu beam filter, and a bowtie filter. The maximal field of view of the system is 41 cm. An anthropomorphic head phantom with a simulated ICH (diameter=0.8 cm, nominal contrast=10 HU) in the right hemisphere and contrast-enhanced cerebral arteries in the left hemisphere was imaged using both the PCD-CT and a state-of-the-art MDCT. The tube potential (80 kV), radiation dose (CTDIvol=17 mGy), slice thickness (5 mm), image pixel size (0.4 mm), and image display W/L were matched between the two CT systems. Images of the phantom were evaluated quantitatively using the CNR of the ICH and subjectively in terms of brain tissue-CSF differentiation, image sharpness, and noise texture.

RESULTS

The small, low contrast ICH was clearly visible in the PCD-CT image. The measured CNR of the ICH was 3.1 for PCD-CT and 2.9 for MDCT. The PCD-CT reconstructions demonstrated a much finer noise texture compared with the MDCT images, and edges of the ICH and small vessels were sharper in PCD-CT. The boundary between brain tissue and CSF was well defined by PCD-CT.

CONCLUSION

The feasibility of intracranial hemorrhage detection using PCD-CT was demonstrated. Initial phantom studies demonstrate that image quality and detection performance for low contrast ICH using the PCD-CT can match clinical MDCT.

CLINICAL RELEVANCE/APPLICATION

The presented PCD-CT system has the potential to address the limited low contrast sensitivity of FPD-based CBCT in assessing the risk of ICH prior to and during endovascular stroke therapy.

SSA21-02 Impact of Tube Voltage (kV) Selection on Spectral-Based Coronary CTA Calcium Plaque Removal for Photon Counting Detector CT (PCD-CT)

Sunday, Nov. 26 10:55AM - 11:05AM Room: S404AB

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PURPOSE

Previous studies demonstrated the feasibility of removing calcified plaques from coronary CT angiograms (CTA) using spectral data. For PCD-CT, higher kV increases spectral performance, whereas lower kV improves iodine visualization in coronary vessels. Our aim was to evaluate the influence of kV selection on vessel iodine contrast, noise and quality of spectral-based calcified plaque removal.

METHOD AND MATERIALS

Four anthropomorphic vessel phantoms simulating coronary arteries (Ø 4 mm) with different combinations of iodine enhancement (500 and 800 HU at 120 kV) and three degrees of calcified stenosis (25, 50 and 75%) & calcium densities (400 and 800 mgHA/cm³) were used in this study. To simulate patient attenuation, an anthropomorphic chest phantom was used. CT images were acquired using a PCD-CT research scanner (SOMATOM CounT, Siemens, Germany). For various dose levels (CTDIvol: 8 to 32 mGy) and four tube voltages (80 to 140 kV), high and low energy bin images were obtained. Images were processed using a modified three material decomposition to separate the data into calcium, soft tissue, and iodine maps. Mixed images, images without coronary calcium and calcium-only images were generated. Iodine enhancement (CT values) and noise (STDEV) were recorded. Quality of the calcium removal was evaluated quantitatively and visually.

RESULTS

For the same dose level, tube voltage minimally influenced image noise. However, for all dose levels, lower tube voltage did result in higher iodine CT values. For example, lumen contrast was 682 HU, 763 HU and 898 HU at 140 kV, 120 kV and 100 kV, respectively. Plaque removal performed better for higher concentrations of iodine and higher densities of calcium. 120 kV and 140 kV led to similar calcium removal quality, whereas the plaque surface appeared fringed at 80 kV and 100 kV due to reduced spectral separation.

CONCLUSION

Removal of calcified plaques using spectral information is feasible irrespective of the selected tube voltage for PCT-CT. However, a substantial improvement in plaque removal quality was observed at 120 and 140 kV. Of these, 120 kV revealed increased vessel contrast.

CLINICAL RELEVANCE/APPLICATION

Reliable removal of calcified plaque in coronary CTA imaging may allow for reduced exam series and more accurate diagnoses.

SSA21-03 Potential of Photon Counting Technique for Next-Generation Type X-Ray Diagnostic System: To Provide New Medical Image Concerning Effective Atomic Numbers Using Plain X-Ray

Sunday, Nov. 26 11:05AM - 11:15AM Room: S404AB

Participants

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TEACHING POINTS

1) Photon counting technique enables the production of a diagnostic X-ray image in which the effective atomic number can be precisely determined. 2) The beam hardening effect should be corrected in order to achieve precise analysis even when a part of the X-ray spectrum is analyzed.

TABLE OF CONTENTS/OUTLINE

1) Aim We aim to propose a novel material identification method based on a photon counting technique. In this system, X-ray spectrum penetrating an object is measured pixel by pixel. Each pixel has the potential to derive material composition of an object. 2) Materials and Methods We proposed a novel method. By dividing the X-ray spectrum into two energy bins, and attenuation factors of the object were calculated. In addition, we proposed a beam hardening correction procedure, which can be applied to two energy bins. The following studies were performed; 1) theory construction, 2) verification experiment using single-probe-type CdTe detector, 3) Monte-Carlo simulation, and 4) demonstration of obtaining a two dimensional X-ray image using a test imaging system. 3) Result and Discussion Our method can determine effective atomic number with an accuracy of +/-0.1 Z under actual clinical conditions during plain X-ray diagnosis. In addition to the traditional X-ray image, effective atomic number image enables precise diagnosis.

PDF UPLOAD

https://abstract.rsna.org/uploads/2017/17004368/17004368_fnrr.pdf

SSA21-04 Assessment of Spatial Resolution in Coronary Stents using Photon-Counting CT Detector: An In-vitro Study

Sunday, Nov. 26 11:15AM - 11:25AM Room: S404AB

Participants

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PURPOSE

To investigate computed tomography (CT) imaging characteristics of coronary stents using a novel photon counting detector (PCD) in comparison with a conventional energy-integrating detector (EID).

METHOD AND MATERIALS

In this in-vitro study, 18 different coronary stents were expanded in plastic tubes of 3 mm diameter, were filled with diluted contrast agent (300mg/ml) and were sealed. Stents were placed in an oil-filled custom phantom calibrated to an attenuation of - 100HU for resembling pericardial fat. The phantom was positioned in the gantry at 2 different angles at 0° and 90° relative to the z-axis and were imaged in a 128-section research dual-source PCD-CT scanner. Detector subsystem "A" used a standard EID, while detector subsystem "B" used a PCD allowing high resolution scanning at two energy thresholds. Images were obtained at identical tube voltage and tube current and were reconstructed using the identical sharp-tissue convolution kernel (B46f). Two independent, blinded readers evaluated in-stent visibility, measured noise, intraluminal stent diameter, and in-stent attenuation for each detector subsystem. Differences in noise, intraluminal stent diameter, and in-stent attenuation where tested using a paired t-test; differences in subjective in-stent visibility were evaluated using a Wilcoxon signed-rank test.

RESULTS

Subjective in-stent visibility was superior in coronary stent images obtained from PCD, compared to EID (p<0.001). The mean intraluminal stent diameter was 22.9% greater in PCD (0.85 ±0.24 mm) compared to EID image acquisition (0.66 ±0.21 mm; p<0.001). Average noise was significantly lower (p<0.001) for PCD (5±0.2 HU) compared to EID (8.3±0.2 HU). In-stent attenuation values were significantly lower for PCD (125.8±77.6 HU) compared to EID (193.5±140.9 HU) (p=0.001).

CONCLUSION

Use of PCD in CT imaging of coronary artery stents yields superior spatial resolution compared to CT scanners equipped with conventional EID at a matched dose.

CLINICAL RELEVANCE/APPLICATION

PCD-CT imaging has superior spatial resolution compared to images obtained with a conventional EID-CT at a matched dose, which improves the in-stent lumen visualization of coronary artery stents.

SSA21-05 Image Quality Assessment and Dose-Efficiency of Quarter-Millimeter Photon-Counting CT of Humans: First In Vivo Experience

Sunday, Nov. 26 11:25AM - 11:35AM Room: S404AB

Participants

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PURPOSE

Current methods of UHR acquisition rely on a the highly dose-inefficient UHR comb that blocks ½ to ¾ of the surface of the detector in order to increase spatial resolution. We investigated the image quality of 0.25mm, ultra-high resolution (UHR) photon-counting detector CT (PCD-CT) acquisition and reconstructions in human subjects. PCDs directly convert x-ray photons into electric pulses and their pixels can be made very small because PCDs do not include scintillating crystals and therefore do not suffer from their physical limitations.

METHOD AND MATERIALS

8 volunteers received brain and lung scans in spiral standard resolution (SR) and axial UHR modes on a whole-body prototype PCD-CT scanner; lungs: 140 kVp, 110 mAs, brain: 120 kVp, 370 mAs. Filtered backprojection reconstructions were made at 0.5 mm isotropic voxel size for SR and UHR data and 0.25 mm isotropic size for UHR data. Noise power spectrum was measured in a 20-cm water-equivalent phantom; image standard deviation was measured in large uniform ROIs in the volunteers. Image resolution was measured in the line pair section of the Catphan CT phantom. HU accuracy was measured in a water phantom with 25 inserts of materials of known concentrations. UHR acquisition reconstructed at 0.25 mm improved image resolution from 9 to 19 LP/cm, with 70% noise increase compared to dose-matched SR acquisition. Interestingly, UHR acquisitions reconstructed at 0.5 mm resolution showed 20% less noise compared to SR images at 0.5 mm, confirmed both in phantom and human measurements. This can be attributed to the reduced noise aliasing due to higher sampling rate of noise in UHR acquisitions. There was no significant bias in the HU values measured in SR and UHR: confidence interval= [-4.6 4.8] HU.

CONCLUSION

0.25-mm PCD acquisition has two advantages: 1- ultrahigh resolution images at acceptable dose levels compared to UHR comb scans (2.8x vs 16x). 2- lower-noise images (20%) when reconstructed at SR voxel sizes, leading to potentially 36% reduction in radiation dose while maintaining image quality.

CLINICAL RELEVANCE/APPLICATION

Ultrahigh-resolution PCD CT markedly improves spatial resolution (19 LP/cm); at standard (0.5 mm) resolution, radiation dose of PCD CT would decrease by 36% compared to conventional detectors.

SSA21-06 Feasibility of Auto-ECG-Gating Technique of 256 Row CT Coronary Angiography in Patients without Heart Rate Control

Sunday, Nov. 26 11:35AM - 11:45AM Room: S404AB

Participants

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PURPOSE

To investigate the feasibility of CT coronary angiography (CCTA) in patients without heart rate control by optimizing the acquisition phase with auto-ECG-gating technology on a 256-row detector CT.

METHOD AND MATERIALS

Total 200 patients with suspected coronary artery disease were enrolled and underwent CCTA with auto-ECG-gating on a 256 row wide detector CT (Revolution CT). Patients were divided into four groups according to the real-time heart rate (HR), group A (50 patients): HR<= 69 bpm; group B (50 patients): HR 70 to 80 bpm; group C (50 patients): HR 81 to 90 bpm; group D: HR>= 91 bpm. The image quality and diagnostic interpretability were accessed by two experienced radiologists blindly with likert 4-point score. The images quality score, diagnostic interpretability and radiation dose were compared with one-way ANOVA or rank sum test among 4 groups.

RESULTS

There were no significant difference of age, sex, and body mass index among four groups, and there was significant difference of image quality score among 4 groups (all P<0.05). Total 800 coronary arteries and 2575 segments were assessed. There were no significant differences of diagnostic interpretability among four groups derived from the segment, coronary artery and patients (P>0.05). The effective radiation dose in A-D groups were (1.05 ± 0.48) mSv, (2.41 ± 1.20) mSv, (1.27 ± 0.55) mSv, (2.66 ± 1.12) mSv(F=29.22,P< 0.001) respectively.

CONCLUSION

It is feasible to perform CCTA in single cardiac cycle in patient without heart rate control by auto-ECG-gating using Revolution CT equipped wide-volume detector.

CLINICAL RELEVANCE/APPLICATION

CCTA can be performed in patients with high heart rate through auto-ECG-gating technology on a 256-row wide-volume detector with low radiation dose.

SSA21-07 Ultimate Pulmonary Imaging: Leading-edge Ultra-High Resolution CT vs Conventional Area Detector CT

Sunday, Nov. 26 11:45AM - 11:55AM Room: S404AB

Participants

Masahiro Yanagawa, MD, PhD, Suita, Japan (*Presenter*) Nothing to Disclose Akinori Hata, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose Osamu Honda, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose Noriko Kikuchi, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose Noriyuki Tomiyama, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose Shinsuke Tsukagoshi, PhD, Otawara, Japan (*Abstract Co-Author*) Employee, Toshiba Medical Systems Corporation Ayumi Uranishi, Osaka, Japan (*Abstract Co-Author*) Employee, Toshiba Medical Systems Corporation

PURPOSE

To compare the image quality between leading-edge ultra-high resolution CT (U-HRCT) and conventional area detector CT (AD-CT).

METHOD AND MATERIALS

Eleven cadaveric lungs were scanned by both U-HRCT (Aquilion Precision™;Toshiba) and AD-CT (Aquilion ONE™;Toshiba). Each cadaveric lung was scanned at 3 different position levels. U-HRCT images were obtained with a 1.5 sec-gantry rotation, 16cm field

of view, and 120kV. Three types of modes were scanned: Normal mode (U-HRCT*N*:Detector element[DM], 896channel, 0.5mmx80row; matrix, 512; pitch factor[PF], 0.81; CTDI, 23.2mGy); Super High Resolution mode (U-HRCT*SR*:DM, 1792channel, 0.25mmx160row; matrix, 1024; PF, 0.81; CTDI, 23.2mGy); and Volume mode (U-HRCT*SR-VOL*: non-helical scan with U-HRCT*SR*; CTDI, 19.2mGy). AD-CT images were obtained with the same conditions of U-HRCT*N* (CTDI, 23.9mGy). All CT images reconstructed at 0.5mm slice thickness were graded on a 3-point scale (1=worse,2=equal,3=better) by 3 independent observers, compared with U-HRCT*N*: 1) Normal CT findings (vessel, bronchi); 2) Abnormal CT findings (ground-glass opacity, consolidation, emphysema, faint and solid nodules, interlobular septal thickening, intralobular reticular opacity, bronchiectasis, honeycombing); 3) Other CT findings (noise, artifacts [streak, dark band], overall image quality). Median scores were used as final evaluations. Noise values were calculated by measuring the standard deviation values in a circular region of interest placed on each selected image. Statistical analysis was performed using Friedman test followed by post-hoc tests.

RESULTS

Both U-HRCT*SR* and U-HRCT*SR-VOL* improved normal and abnormal CT findings and reduced streak and dark band artifacts significantly more than AD-CT(p<0.014). U-HRCT*SR-VOL* improved a visual noise better than U-HRCT*SR* and AD-CT(p<0.00001). Quantitative noise values were significantly higher in order of U-HRCT*SR*(median, 29.5), U-HRCT*SR-VOL* (26.2), AD-CT(15.9), and U-HRCT*N*(14.2)(p<0.0001). U-HRCT*SR* and U-HRCT*SR-VOL* significantly provided higher overall image quality than AD-CT almost equal to U-HRCT*N*(p<0.0001).

CONCLUSION

U-HRCT*SR* and U-HRCT*SR-VOL* can provide higher image quality than AD-CT. U-HRCT*SR-VOL* is also more advantageous in noise than U-HRCT*SR*.

CLINICAL RELEVANCE/APPLICATION

U-HRCTSR and U-HRCTSR-VOL might contribute more detailed evaluations in lung by substantially improving image quality than AD-CT.

SSA21-08 Reducing Pseudo Enhancement of Liver Cyst with Virtual Monochromatic Spectral Images: A Clinical Application Study

Sunday, Nov. 26 11:55AM - 12:05PM Room: S404AB

Participants

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PURPOSE

To evaluate the clinical value of using virtual monochromatic spectral (VMS) images to reduce pseudo-enhancement of liver cysts.

METHOD AND MATERIALS

10 patients with a total of 26 small liver cysts (the long diameter of less than 2 cm) who underwent enhanced spectral CT scans were included. Lesions were confirmed by the combination of ultrasound, MR and multi-phase abdominal spectral CT imaging to be liver cyst. Plain CT, contrast enhanced spectral CT scans in cortical phase (25-30s delay) and portal venous phase (60-70s delay) were performed. The 140kVp polychromatic images and 70keV VMS image of 1.25mm and 5mm thickness were reconstructed in the cortical phase and portal venous phase. CT number difference between the enhanced-phase image and the pre-contrast image was calculated, and the enhancement (pseudo) was assumed when the CT number difference was greater than the historical value of 10HU. The 140kVp polychromatic image was used as a reference to represent conventional CT imaging condition.

RESULTS

The minimum and maximum diameters of the 26 cysts were 4.7mm and 19.5mm, respectively. Using the 140kVp polychromatic image, one observed 5 and 14 pseudo-enhanced cysts in the cortical phase and portal venous phase, respectively in the 5mm slice images; and 3 and 8 cases of pseudo-enhancement in the 1.25mm slice images. The pseudo enhancement was greatly reduced to 3 and 7 cases for the 5mm slice thickness and 2 and 3 cases for the 1.25mm slice in the cortical phase and cortico-medullary phase, respectively when the 70keV VMS images were used. The total number of pseudo enhancement in the 5mm slice polychromatic images (19) was markedly reduced to 11 with the use of 1.25mm slice images (P=0.08), and was further reduced to 5 when the 70keV VMS images of 1.25mm thin slice was used (P=0.001).

CONCLUSION

The pseudo enhancement of small liver cysts existed based on the CT number threshold and influenced by image thickness. Compared with conventional polychromatic and thick slice mode, virtual monochromatic spectral images in its thin slice form can considerably reduce the phenomenon of small liver cysts pseudo-enhancement.

CLINICAL RELEVANCE/APPLICATION

Thin slice virtual monochromatic spectral images can greatly reduce the phenomenon of pseudo enhancement of small liver cysts. They have a role in identifying real enhancement characteristics of lesions.

SSA21-09 Comparison of X-Ray Phase Contrast CT at a Synchrotron Facility with Conventional Imaging Modalities on Wrists

Sunday, Nov. 26 12:05PM - 12:15PM Room: S404AB

Barbara Fayard, Grenoble, France (*Abstract Co-Author*) Nothing to Disclose Sylvain Bohic, Grenoble, France (*Abstract Co-Author*) Nothing to Disclose Herve Mathieu, la tronche, France (*Abstract Co-Author*) Nothing to Disclose Jean Noel Ravey, la Tronche, France (*Abstract Co-Author*) Nothing to Disclose Yohann Robert, la Tronche, France (*Abstract Co-Author*) Nothing to Disclose Philippe Gaudin, la Tronche, France (*Abstract Co-Author*) Nothing to Disclose Sebastien Berujon, Grenoble, France (*Abstract Co-Author*) Nothing to Disclose Emmanuel Brun, Grenoble, France (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

None of the current conventional medical imaging approaches permit to visualize and differentiate in a single image all the different tissues of a joint. For instance, X-ray absorption based Computed Tomography (CT) shows limitations for the imaging parts presenting a weak density. Although Magnetic Resonance Imaging (MRI) is crucial for soft tissue it struggles to render properly the bony changes using conventional routine sequences. Phase Contrast Imaging (PCI) takes advantage of the dual properties of the X-rays to reveal sample enhanced details of simultaneously soft and hard materials. This work presents qualitative comparison between PCI using Propagation Based Imaging CT and today's conventional medical imaging modalities (CT/MRI/US).

METHOD AND MATERIALS

PCI images were acquired using a monochromatic X-ray beam whose energy was set to 60:keV (22 μ m voxel size). The sample and the detector were positioned 11:m apart. The qualitative image comparison was carried out based on 3 cadaveric human wrists. The samples were maintained fixed in dedicated containers filled with formaldehyde.

RESULTS

The results show higher image quality in PCI data sets compared to conventional clinical multi-modality imaging. Equivalently to conventional MRI routine sequence, PCI images offer good contrast for the soft tissues. In addition, spongy lamellar bone tissues are also better rendered with PCI than with clinical CT, making details of the trabeculae visible. The PCI superiority in terms of both resolution and contrast helps to differentiate the various components such as the cartilages, ligaments and muscles. The figure presents axial right wrist images reconstructed from (a) conventional CT, (b) PCI CT on a synchrotron source (b) and (c) MRI T2 sequence

CONCLUSION

This proof of concept experiment demonstrates the potential of the PCI in terms of image quality. This pre-clinical study lets foresee a widespread use of coherent X-ray sources for medical imaging in a near future. In this context, new of under development compact X-ray technologies are watched with interest.

CLINICAL RELEVANCE/APPLICATION

This study provides a comparative study of synchrotron Phase Contrast Imaging CT of wrists with hospital conventional imaging modalities (CT/MRI/US).





103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA22

Physics (MR: Applications)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S405AB



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

Participants

Edward F. Jackson, PhD, Madison, WI (*Moderator*) Nothing to Disclose Stephen J. Riederer, PhD, Rochester, MN (*Moderator*) Nothing to Disclose

Sub-Events

SSA22-01 Reproducibility of GABA in Occipital Lobe in Healthy Subjects Employing Mega-press at 3T

Sunday, Nov. 26 10:45AM - 10:55AM Room: S405AB

Participants

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PURPOSE

To evaluate the reproducibility of γ -aminobutyric acid (GABA) in occipital lobe of normal subjects at 3T.

METHOD AND MATERIALS

Spectroscopic data were acquired from occipital lobe region in 16 normal adult volunteers (9 males and 7 females; mean age: 23.5 \pm 1.3) using J-editing technique and MEGA-PRESS pulse sequence (the sequence was developed on the platform of Siemens MR system, TR/TE=2000 ms /68 ms, VOI=25 \times 25 \times 25 mm3, BW=1200 Hz, Measurements=320, the editing pulses applied at 1.9 ppm or 7.5 ppm in an interleaved manner) at a 3T scanner, and each subject scanned twice (duration between scans: 7 days). The GABA data divided into three groups, Visit1, for the first scan, Visit2, for the second scan, and Visit1&2, for the first and second scans, respectively. The reproducibility of GABA was assessed by the GABA+/NAA ratio, coefficient of variation (CV) and t-test.

RESULTS

The mean GABA+/NAA ratio in the two scans of each subject was ranged from 0.179 to 0.283 (Fig. 1), during which the CVs were below 10% in eleven subjects. The mean GABA+/NAA ratios of different groups were similar, and with the CVs below 15% (Tab. 1). The t-test result showed that the two scans of all subjects had no significant difference (p=0.480). The mean GABA+/NAA ratio of male group were higher than that of female group, however, the CVs of male group were lower than that of female group (Tab. 2). In addition, the t-test results also suggested that the two scans of both the two groups had no significant difference (p=0.280, p=0.973). However, significant difference was found in the mean GABA+/NAA ratios between the two groups (p=0.022).

CONCLUSION

The measurements of GABA in occipital lobe demonstrated a good reproducibility in healthy volunteers with J-editing technique and MEGA-PRESS pulse sequence at 3T, and the mean relative concentration is higher in male than that in female.

CLINICAL RELEVANCE/APPLICATION

Detection of GABA in occipital lobe demonstrated a good reproducibility in healthy volunteers with J-editing technique and MEGA-PRESS pulse sequence is recommended in the evaluation of human brain GABA concentration.

SSA22-02 Quality Assurance of Diffusion Weighted Imaging: Comparison of a New ACR Phantom Based Method with the QIBA Method

Sunday, Nov. 26 10:55AM - 11:05AM Room: S405AB

Awards

Student Travel Stipend Award

Participants Eric Cameron, BS, West Lafayette, IN (*Presenter*) Nothing to Disclose Ulrike Dydak, PhD, West Lafayette, IN (*Abstract Co-Author*) Nothing to Disclose Chen Lin, PhD, Jacksonville, FL (*Abstract Co-Author*) Research Grant, Siemens AG

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PURPOSE

Quality Assurance (QA) of diffusion weighted imaging (DWI) as recommended by the RSNA Quantitative Imaging Biomarkers Alliance (QIBA) requires a special ice water phantom that is not widely available and difficult to prepare. The ACR phantom, however, is available in many clinical MRI facilities and used for weekly QA. Therefore, it would be beneficial to develop a DWI QA procedure based on the ACR phantom (ACR DWI QA) that can be integrated into the weekly QA. The purpose of this work is to develop such a method and compare with the QIBA method.

METHOD AND MATERIALS

QIBA DWI QA was performed according to QIBA protocol (http://qibawiki.rsna.org/). For ACR DWI QA, the following adjustments were made: TR=5000ms due to a shorter T1, and averages of 2, 2, 4 and 8 for b=0, 500, 900 and 2000 s/mm2 to improve the SNR. The temperature of the ACR phantom was measured pre-/post-scan with a laser thermometer [Dr. Meter IR-20] (accuracy<1°C). Comparison of QIBA and ACR DWI QA was performed on two different scanners: 1) a Siemens 3T Prisma using a 20ch head&neck coil and 2) a GE 3T MR750 using an 8ch head coil. Apparent Diffusion Coefficient (ADC) maps were generated by the built-in software on the scanners. The mean ADC value in three different ROIs as shown in fig. 1 were averaged and compared against the theoretical value described by Holz et al. 2000 (PCCP) at the measured temperature to determine the deviation of ADC.

RESULTS

The mean deviation of ADC based on ACR DWI QA was 0.89% (SD $\pm 0.71\%$) for scanner 1 and 2.55% (SD $\pm 0.62\%$) for scanner 2. For QIBA DWI QA, they were $0.61\pm 0.63\%$ and $2.59\pm 0.39\%$, respectively. The measured ADC with ACR DWI QA was highly reproducible and the deviation was consistent with QIBA DWI QA.

CONCLUSION

A new DWI QA method based on the ACR phantom was shown to be reproducible and able to detect similar ADC deviation as the QIBA DWI QA method. The new method is simpler and more feasible for the clinical environment although it is limited to one ADC value and correction for phantom temperature could be an additional source of error.

CLINICAL RELEVANCE/APPLICATION

Development of a DWI QA procedure using the ACR phantom would allow any ACR accredited institution to implement a DWI QA as a part of the weekly QA without additional phantoms or preparation.

SSA22-03 Modulation Transfer Function of Clinical Brain 3D-FLAIR Sequence

Sunday, Nov. 26 11:05AM - 11:15AM Room: S405AB

Participants

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PURPOSE

Typically, image quality in magnetic resonance imaging is evaluated either quantitatively from quality control (QC) phantom images or subjective observer based evaluation of clinical images. However, the phantom-based quality measurements may not fully represent the quality of actual clinical images. An important image quality metrics among image noise and contrast is spatial resolution. In medical imaging, spatial resolution is often characterized by the modulation transfer function (MTF) at a known boundary. It describes the image contrast content at different spatial frequencies. We have developed a method to characterize image resolution by measuring MTF directly from clinical brain volumes obtained with 3D-FLAIR sequence.

METHOD AND MATERIALS

Edge profiles are extracted from a brain surface and direction-dependent MTFs are calculated. First, the original 3D-FLAIR volume is segmented using Statistical Parameter Mapping (Wellcome Trust Centre for Neuroimaging, University College London, UK). The brain mask is further trimmed with an in-house MATLAB (The Mathworks Inc., Natick, MA, USA) application. A mesh grid is fitted onto the mask volume using MATLAB-based open source toolbox iso2mesh. A typical brain surface grid includes from 150 000 to 250 000 triangular polygons. Voxel gray values and distances from the grid are then recorded within cylindrical volumes perpendicular to each polygon face and intersecting the polygon center. Each resulting edge spread function (ESF) is filtered according to predetermined acceptance criteria and the accepted ESFs are centered on the detected edge. Resulting ESFs are averaged, differentiated and Fourier transformed to obtain direction-dependent MTFs.

RESULTS

The developed method was able to determine brain surface direction-dependent MTFs from clinical 3D-FLAIR volumes. Resolution trend curves were calculated over a period of nine months.

CONCLUSION

The developed method provides a quantitative tool for measuring MTF directly from clinical 3D brain images. The MTF can be used to the compare spatial resolution in image volumes obtained with different sequence parameters and scanners. The method can be also applied on-line to follow daily image quality to detect technical or patient related issues.

CLINICAL RELEVANCE/APPLICATION

The calculation of clinical MRI volume MTF provides a quantitative tool for protocol optimization or evaluating and comparing scanners or sequences.

Participants

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PURPOSE

To use data regarding MRI patents approved by the U.S. Patent and Trademark Office (USPTO) in 2016 to characterize recent trends in MRI technical development and innovation.

METHOD AND MATERIALS

The USPTO website was searched for all patents with an issue date in 2016 and a patent abstract containing the phrase "magnetic resonance". Patent characteristics available on the website were recorded. Patent assignees were manually characterized as having an industry or academic affiliation. An MRI physicist reviewed the abstracts to classify patents' themes. Observations were summarized using standard descriptive statistics.

RESULTS

A total of 423 MRI-related patents were approved by the USPTO in 2016. Of these, a total of 29% had 1 inventor, 24% had 2 inventors, and 47% had >=2 inventors (maximum of 10 inventors). The mean interval between patents being filed and awarded was 1389 \pm 559 days (range, 559 to 1,327 days). The most common countries of patents' first assignee were: USA (40%), Germany (24%), Netherlands (10%), Japan (10%), and Korea (4%). There were 14 additional countries (each <2%). A total of 3% of patents included multiple assignees having different countries (most common collaborators being USA and Germany). Patents' 1st assignee had an industry affiliation in 76% vs. an academic affiliation in 21% (4% were indeterminate). A total of 3% of patents had industry-academia collaboration. Patents' most common themes were: coils (n=77), sequence design (n=65), and non-coil scanner hardware (n=41). These top themes were similar for USA, international, and industry based patents; however, for academic based patents, the most common themes were: sequence design, reconstruction, and exogenous agents. Less common themes included: image analysis, post-processing, spectroscopy, relaxometry, diffusion, motion correction, radiation therapy, implants, wireless devices, and PET/MRI.

CONCLUSION

The majority of MRI-related patents approved by the USPTO in 2016 were filed by non-U.S. inventors. A large majority had an industry affiliation; minimal industry-academic collaboration was observed. Patents from industry and academic inventors had distinct top focuses: hardware and software, respectively.

CLINICAL RELEVANCE/APPLICATION

Awareness of the most recent years' MRI patents may provide insights into forthcoming clinical translations and help guide ongoing research and entrepreneurism.

SSA22-05 SI-traceable Imaging Phantoms for MRI

Sunday, Nov. 26 11:25AM - 11:35AM Room: S405AB

Participants Stephen E. Russek, PhD, Boulder, CO (*Presenter*) Nothing to Disclose Michael Boss, PhD, Boulder, CO (*Abstract Co-Author*) Nothing to Disclose Kathryn E. Keenan, PhD, Boulder, CO (*Abstract Co-Author*) Nothing to Disclose Karl Stupic, PhD, Boulder, CO (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To develop primary calibration structures for MRI that have precisely defined properties traceable to the International System of Units (SI). Properties include T1 and T2 proton-spin relaxation times, apparent water diffusion coefficients (ADC), resolution, and geometric distortion. In addition to the primary measurands, the properties of the phantom structure, including dielectric constant, conductivity, and magnetic susceptibility must be determined to fully understand and model MRI-based measurements.

METHOD AND MATERIALS

A suite of MRI phantoms have been designed, fabricated, and commercialized including a system phantom, a diffusion phantom and a breast phantom. These phantoms include paramagnetic solutions for T1 T2 arrays, polymer solutions for ADC calibration, fiducial spheres for geometric distortion, and fat/tissue mimics. The properties of phantom materials are determined through temperaturecontrolled variable-field NMR, imaging on a MRI metrology scanner, electromagnetic properties measurements, and SQUID magnetometry.

RESULTS

Rigorous but pragmatic definitions of parameters for the major MRI biomarkers have been developed. SI traceable measurement protocols for T1, T2 and ADC and initial measurements have been completed. SI-traceable measurements, with the associated certificates, are expected within 12 months. The phantoms are currently being used at clinical research sites to evaluate new faster quantitative imaging techniques, to homogenize images across scanners, and to develop quality control recommendations for clinical trials evaluating diffusion-based imaging for cancer detection/monitoring. These initial uses have indicated that it is necessary to guarantee phantom-parameter accuracy and stability of 2%.

CONCLUSION

As medical imaging improves with increased reliance on qualitative measurement of critical biomarkers, there is an increasing need for more rigorous calibration structures with the associated SI-traceable measurement of their properties. We have developed a suite of phantoms and associated measurement structure to supply this need.

CLINICAL RELEVANCE/APPLICATION

These phantoms have been used to validate new, faster quantitative imaging techniques such as MR fingerprinting, homogenize scan protocols across different scanner types, assess the change in performance of scanners due to upgrades, assess advanced diffusion imaging protocols in cancer studies and traumatic brain injury diagnosis.

SSA22-06 Display Color in the Interpretation of Apparent Diffusion Coefficient Maps for Prostate Cancer

Sunday, Nov. 26 11:35AM - 11:45AM Room: S405AB

Awards

Student Travel Stipend Award

Participants

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PURPOSE

Color visualization is prevalent in functional and molecular imaging, the source of most reported imaging biomarkers. Color display selection varies across imaging departments because no guidelines are available and no study has evaluated reader consistency using visualization approaches. In prostate patients, water movement restriction areas in apparent diffusion coefficient (ADC) maps correlate with significant cancer. Inconsistency in quantification and localization reported could result in suboptimal patient management. We report radiologist consistency in detection of prostate lesions to determine the effect of color visualization approaches on diagnostic performance.

METHOD AND MATERIALS

Nine trained readers interpreted 165 single-slice cases, each reading sets of 55 images in 3 separate sessions using a different color scale: gray (G), hot-iron (H), and the inverted rainbow scale (iR). The standard RGB display mode was used for H and iR sessions and the GSDF mode was selected for G. Five readers repeated sessions with iR and H in GSDF mode. Readers used a 0-100 scale to rate their confidence in the presence of a malignant tumor. For cases scored above 50, readers were asked to mark the lowest ADC value within the detected lesion. Pixel values and coordinates were recorded.

RESULTS

The area under the receiver-operating-characteristic curve (AUC) was compared across color scales. Obtained AUCs were 0.79, 0.77 and 0.80 (SE = 0.03) for G, H and iR, respectively, demonstrating a small improvement in detection performance when using iR. A tendency for higher detection sensitivity was observed for RGB setting compared to GSDF for H and iR. Inconsistencies on lesion quantification and localization were non-significant across scales. These results significantly differ from those in a similar study for ischemic lesion detection in myocardial perfusion CT where performance was up to 0.1 AUC units higher using G.

CONCLUSION

Differences in quantification and localization consistency were non-significant. Further investigation is necessary to determine if color affects other diagnostic tasks.

CLINICAL RELEVANCE/APPLICATION

Our findings suggest a small non-significant impact of color for prostate lesion detection in ADC maps, disagreeing with a significant color effect observed in a similar study performed on a different modality.

SSA22-07 Quantitative Estimation of CSF Flow Using MRI Phase Contrast Technique to Assess the Postoperative Outcome of Chiari 1 Malformation with Syringohydromyelia

Sunday, Nov. 26 11:45AM - 11:55AM Room: S405AB

Participants

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PURPOSE

To quantify the postoperative outcome of chiari 1 malformation using CSF flow study. To evaluate the efficacy of surgery and to assess the prognosis in the early postoperative period.

METHOD AND MATERIALS

Fifty patients with chiari 1 malformation with syringohydromyelia who are ideal candidate for surgery were subjected to MRI brain and spine and CSF flow analysis using MR phase-contrast technique. Region of interest was kept at the level of aqueduct and assessed the positive peak velocity, negative peak velocity and flow. All patients underwent posterior fossa decompression surgery. Post operative velocity and flow measurements of all patients were taken. We compared the pre and post operative flow volume and velocity.

RESULTS

Of the 50 patients, 36 patients showed significant change in the velocity and flow in the early postoperative period and had resolution of clinical signs and symptoms during follow up. 10 patients showed mild changes in flow and velocity in the early postoperative period with partial recovery of symptoms during follow up and in 4 patients , there is minimal change in velocity and flow during early postoperative period with persistence of symptoms during follow up.

CONCLUSION

Patients with significant changes in flow and velocity in the early postoperative period will have better clinical recovery when compared to patients with minimal change.

CLINICAL RELEVANCE/APPLICATION

Improved CSF velocity and flow in the early postoperative period is useful in anticipation of symptomatic improvement and useful in assessing the efficacy of surgery and long term prognosis.

SSA22-08 Non-ECG-gated and Non-enhanced MR Venography in Arrhythmia

Sunday, Nov. 26 11:55AM - 12:05PM Room: S405AB

Participants

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PURPOSE

To selectively visualize lower extremity varicose veins in arrhythmia patients without contrast media by the use of a free-ECG-gating Flow-Sensitive Black Blood (FSBB) technique.

METHOD AND MATERIALS

A FSBB technique doesn't need an ECG-gating and allows b values to be adjusted in increments of 0.1 value as one-tenth of usual 1 value. A protocol optimization was performed on 20 healthy volunteers while they changed their lower limb position up and down in the supine or seated position. Subsequently, the revised FSBB protocol parameters were applied to 25 arrhythmia patients of varicose veins with difficulty in diagnosis on usual ECG-gated MRA techniques. All the studies were performed on a 1.5T MRI system (EXCELART Vantage XGV Toshiba) equipped with a SPEEDER torso coil. FSBB imaging was performed as follows; T2*-weighted 3D gradient echo sequence, b value; 0.1-0.4, and typical scan time; 5 min. The performance of FSBB on the lower extremity venous systems was assessed for the image contrast as compared with the other unenhanced ECG-gated MRA techniques.

RESULTS

The scan time of FSBB was almost equal to that of time-of-flight (TOF) and half-Fourier FSE MRA (FBI) using usual ECG-gating techniques. Unenhanced MRA showed excellent depiction of complex venous plexus and age-related vasodilatation while changing their lower limb positions, especially in their legs lowered on seated position. FSBB provided an excellent anatomical depiction of tortuous varicose veins in arrhythmia patients as a dynamic imaging.

CONCLUSION

FSBB technique is independent of ECG-gating and allows exam integrity even in arrhythmia patients and can consequently shorten exam time, so it may provide a valuable procedure for diagnosis of peripheral vascular imaging. Selective visualization of varicose sources in arrhythmia patients without contrast media is of increasing significance for an interventional procedure in our aging population.

CLINICAL RELEVANCE/APPLICATION

Visualization of the lower limb venous systems of arrhythmia patients without contrast material is quite difficult using conventional unenhanced MR angiography. FSBB imaging is a new clinical tool with the use of MR susceptibility difference between tissue and vessels. It has been proven to be useful for brain imaging. In this study, we extended the application of FSBB to the lower extremity veins to investigate if FSBB could provide an additional benefit beyond the brain.

SSA22-09 Advanced Fat Suppression Techniques for Off-Center Upper Extremity MSK MRI on 3T Scanners

Sunday, Nov. 26 12:05PM - 12:15PM Room: S405AB

Participants Judy R. James, PhD, Phoenix, AZ (*Presenter*) Nothing to Disclose Mark J. Kransdorf, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose Yuxiang Zhou, PhD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose Anshuman Panda, PhD, Scottsdale, AZ (*Abstract Co-Author*) Nothing to Disclose

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CONCLUSION

Field sensitive sequences like Spectral FS techniques can have fat suppression inhomogeneities, signal loss and blurring due to gradient pulsing and higher order eddy currents with off-center scans on 3T. Depending on patient position, the FS sequence parameters may need to be adjusted to minimize these effects.

Background

3T MR scanners provide high quality MR images, better SNR and resolution in shorter scan times. However, fat suppression on 3T is challenging for wrist and elbow MSK scans; specifically, off-center scans with small FOV. We observed inhomogeneous fat suppression, non-patient-motion related ghosting/ blurring and poor SNR on 3T for off-center scans using traditional spectral fat suppression (FS). The same protocols on iso-center scans produced excellent image quality.

Evaluation

Multiple phantom and wrist scans were performed on volunteers to determine the source for poor image quality. Mapping of the B1 (RF) field, static B0 field and the dynamic B0 field with the body coil and wrist coil were performed. Qualitative and quantitative comparisons were made with the spectral FS sequence with changes in gradient pulsing. Scan parameters were changed to maximize SNR with complete and uniform fat suppression while maintaining small FOV and high resolution requirements.

Discussion

Analysis showed that the primary source of inhomogeneous FS and lower SNR for off-center scans on 3T was higher order eddy currents (dynamic B0 field) due to gradient pulsing. No static B0 or B1 (RF) field inhomogeneities were found to be contributing to the issues. Changing the gradient pulsing changed the FS results, further confirming that errors observed were dynamic in nature. Swapping the phase or reversing the polarity of the phase encoding direction for right vs. left MSK scans, depending on the patient position (head or feet first, right or left, supine or prone) helped improve the image quality for off-center scans in terms of SNR and signal uniformity. STIR and SPAIR sequences were not evaluated due to image contrast differences from traditional sequences. But DIXON water images were chosen to be a backup if traditional off-center FS with eddy-current compensation failed.



KSNA° 2017

103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



SSA23

Radiation Oncology (Radiobiology)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S104A



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

FDA Discussions may include off-label uses.

Participants

Edward Y. Kim, MD, Seattle, WA (*Moderator*) Nothing to Disclose Meng X. Welliver, MD, Columbus, OH (*Moderator*) Nothing to Disclose

Sub-Events

SSA23-01 DNA Damage in Lymphocytes after Low Dose Chest CT

Sunday, Nov. 26 10:45AM - 10:55AM Room: S104A

Participants

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Research Grant, Bayer AG; Research Grant, Daiichi Sankyo, Ltd; Research Grant, Eisai, Ltd; Medical Adviser, GE Healthcare;
Research Grant, Fujitsu Ltd; ; ; ; ; ;

PURPOSE

CT is now the largest source of radiation exposure in diagnostic imaging and the risk of cancer from CT is a rising concern in the medical community. Therefore, various imaging techniques including iterative reconstruction algorithms have been developed to reduce radiation dose. With these techniques, chest CT can be scanned with low dose (effective radiation dose: 1-3mSv). Although earlier studies reported that DNA damage was induced by CT, it is yet unknown at what dose DNA damage is likely to occur. The purpose of this study was to determine whether DNA damage can occur with low-dose chest CT.

METHOD AND MATERIALS

We obtained institutional review board approval and the written informed consent from 74 patients (32 men, 42 women, median age 69 years, range 28-87 years) who underwent low dose chest CT. All low dose chest CT were scanned on a 320-detector CT scanner (Aquilion One; Toshiba Medical Systems, Otawara, Japan) in helical scan mode. The scan parameters were 120 kVp, 100mA, rotation time 0.5 sec, detector configuration 80 x 0.5mm. Blood samples were obtained before- and 15 minutes after CT. We identified DNA damages (DNA double-strand breaks) in lymphocytes as cytologically visible "foci" by using an antibody against γ -H2AX. The statistical difference was determined by two-sided paired t test. Difference with P < 0.05 was considered significant.

RESULTS

The mean γ -H2AX foci number before CT and 15 minutes after CT were 3.3 (SD: 2.2) and 3.3 (2.4) foci/cell, respectively. The γ -H2AX foci number was not significantly increased after CT. The mean effective dose of low dose chest CT was 1.9 (0.2) mSv.

CONCLUSION

Low-dose chest CT failed to induce DNA double strand breaks in lymphocytes.

CLINICAL RELEVANCE/APPLICATION

Our results may prove biological validity for CT lung cancer screening from the standpoint of radiation exposure.

SSA23-02 Nanoparticle Imaging and Treatment of Primary and Metastatic Tumor, Through Macrophage Therapy and the Abscopal Effect, Respectively, by Radiotherapy-Directed Targeted Switching of TAMs from an M2 to M1 Phenotype and Activation of Primed CD8+ T Ce

Sunday, Nov. 26 10:55AM - 11:05AM Room: S104A

Participants

Satoshi G. Harada, MD, Morioka, Japan (*Presenter*) Nothing to Disclose Takashi Segawa, Morioka, Japan (*Abstract Co-Author*) Nothing to Disclose Shigeru Ehara, MD, Morioka, Japan (*Abstract Co-Author*) Nothing to Disclose Takahiro Satoh, DSc, Takasaki, Japan (*Abstract Co-Author*) Nothing to Disclose Koichiro Sera, Takizawa, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

We aimed to image and treat primary tumors and metastasized tumors in vivo through macrophage-based therapy and abscopal

effect, respectively, in LM17 cell xenografts in BALB/c mice using microcapsules that released liposome-protamine-hyaluronic acid nanoparticles (LPH-NPs) in response to three sessions of radiation.

METHOD AND MATERIALS

For session one, LPH-NPs containing 5% iopamiron, and 250 nmol anti-CD47 siRNA were mixed with 1.0 mL oxygen-rich solution (2200 ppm O2) containing 4.0% alginate, 3.0% hyaluronate, and 1 μ g/mL P-selectin antigen (Ag) solution and added to 0.5 mM FeCl2 with 1 μ g/mL a4B1 antibody (Ab). The microcapsules (1 × 1010) were injected intravenously (IV). After 9 h, primary tumors were exposed to 10 or 20 Gy 60Coγ-rays. In session two LPH-NPs containing 200 μ g anti-CD40 monoclonal Ab (MAb) and 9.0 × 105 IU IL-2 were mixed with the above cocktail and added to 0.5 mM FeCl2 with 1 μ g/mL anti-P-selectin Ab. Microcapsules (1 × 1010) were injected IV and they interacted with P-selectin. After 9 h, the second radiation session was conducted using the same protocol as for the first session. In session three, 4 cGy 60Co whole-body γ -rays were administered at 24-h intervals for 5 days.

RESULTS

Following session one, anti-a4B1 microcapsules accumulated around the primary tumors and metastases, which were detected by CT. The microcapsules released P-selectin Ag, anti-CD 47 siRNA LPH-NPs and O2-rich water, which silenced "don't eat me" signals and increased [O2] in tumors. In session two, the microcapsules accumulated around the primary tumor through a P-selectin Ag-Ab reaction. By second radiation, released LPH-NPs containing anti-CD 40 MAb /IL-2 switched the phenotype of Tumor Associated Macrophages (TAMs) from M2 to M1, and repeatedly released an O2-rich water inhibited TAMs from repolarizing back to M2 phenotype, which intensified tumor phagocytosis by M1 macrophages. Additionally, anti-CD 40 MAb enhanced cross priming of CD8+T-cells to tumor. In session three, primed CD8+T-cells were activated and attacked metastases. These treatments reduced the size of primary tumors and metastases by $87 \pm 4.6\%$.

CONCLUSION

Our targeted macrophage therapy has the potential to improve tumor diagnosis and treatment.

CLINICAL RELEVANCE/APPLICATION

Nanoparticles improved tumor imaging. Targeted switching of macrophage phenotype from M1 to M2 and cross priming of CD8+ T-cells enhanced the effects of radiotherapy on primary tumors and metastases.

SSA23-03 Inhibitors of HIF-1a and CXCR4 Mitigate the Development of Radiation Necrosis in Mouse Brain

Sunday, Nov. 26 11:05AM - 11:15AM Room: S104A

Participants Ruimeng Yang, MD,PhD, Guangzhou, China (*Presenter*) Nothing to Disclose Chong Duan, ST.LOUIS, MO (*Abstract Co-Author*) Nothing to Disclose Liya Yuan, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose John A. Engelbach, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose Christina I. Tsien, MD, Saint Louis, MO (*Abstract Co-Author*) Speaker, Merck & Co, Inc Scott C. Beeman, PhD, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose Xia Ge, St Louis, MO (*Abstract Co-Author*) Nothing to Disclose Keith M. Rich, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose Joseph J. Ackerman, PhD, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose Joseph J. Ackerman, PhD, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

There is mounting evidence to indicate that, in addition to angiogenesis, hypoxia-induced inflammation via the hypoxia inducible factor-1a (HIF-1a) / CXC chemokine receptor-4 (CXCR4) pathway, may also contribute to the pathogenesis of late-onset, radiation-induced necrosis (RN). In the present study, we investigated the mitigative efficacy of an HIF-1a inhibitor, topotecan, and a CXCR4 antagonist, AMD3100, on the development of RN in an intracranial mouse model.

METHOD AND MATERIALS

Mice received a single-fraction, 50-Gy dose of hemispheric radiation using the Leksell GammaKnife and were then treated with either topotecan, from 1-12 weeks post-irradiation (PIR), or AMD3100, from 4-12 weeks PIR. The onset and progression of RN were monitored longitudinally via noninvasive, in vivo MRI from 4 to 12 weeks PIR. Conventional hematoxylin and eosin (H&E) staining and immunohistochemistry (IHC) staining were used to further evaluate the treatment response.

RESULTS

The progression of brain RN was significantly mitigated in mice treated with either topotecan or AMD3100, compared to control animals. MR-derived lesion volumes were significantly smaller for both of the treated groups, and histologic findings correlated well with the MRI data. By H&E staining, both treated groups demonstrated reduced radiation-induced tissue damage compared with controls. Further, the IHC results revealed that expression levels of VEGF, CXCR4, CXCL12, Iba-1, CD-68, CD3 and TNF-a in the lesion area were lower in treated brains vs. control brains. HIF-1a expression persisted in topotecan-treated animals, but was reduced markedly by treatment with AMD3100. IL-6 expression was unaffected by either topotecan or AMD3100.

CONCLUSION

By mitigating inflammation, both topotecan and AMD3100 can, independently, mitigate the development of RN in mouse brain. When combined with first-line, anti-angiogenic treatment, anti-inflammation therapy may provide an adjuvant therapeutic strategy for clinical, post-radiation management of tumors, with additional benefits in the mitigation of RN development.

CLINICAL RELEVANCE/APPLICATION

(Dealing with radiation necrosis and inflammation)Treatment with topotecan or AMD3100 can significantly inhibit the HIF-1a/CXCR4 axis, thereby reducing the progression of RN. Targeting the HIF-1a/CXCR4 pathway may be a promising therapy in treating

recurrent tumor post-RT, with additional benefit for mitigating the progression of RN'.

SSA23-04 Radiation Inhibits Lymphangiogenesis in Acquired Lymphedema Hindlimb Mouse Models

Sunday, Nov. 26 11:15AM - 11:25AM Room: S104A

Participants

Zhe Wang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose Kun Yung Kim, MD, Jeonju-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Ho-Young Song, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Jiaywei Tsauo, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Min Tae Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Jung-Hoon Park, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

This study was aimed to evaluate the effect of radiation on acquired lymphedema in hindlimb mouse model.

METHOD AND MATERIALS

Total 20 BALB/c female mice of 8-week-old were equally assigned to two groups. In both groups, popliteal lymph node and surrounding fat pad were resected. In radiation group, all mice received 20 Gy radiation exposure 1 day after surgery. The methods of evaluation include measuring the thickness of ankle, fluorescence lymphography at the end of 1, 2, 3, 4 week.

RESULTS

The mean thickness values of ankle in radiation group at 1,2,3,4 weeks were 4.64 mm, 4.26 mm, 3.98 mm, 3.80 mm, respectively. The mean thickness values of ankle in non-radiation group at 1,2,3,4 weeks were 4.29 mm,4.10 mm,4.27 mm, 4.02 mm, respectively. Difference was statistically significant in 1 week and 2 weeks (P<0.05). Collateral lymph vessels draining to the inguinal LN were detected in 10% of mice in radiation group, but 100% of mice in non-radiation group at 4 week fluorescence lymphography.

CONCLUSION

Radiation inhibits the lymphangiogenesis after popliteal lymph node resection, which indicates that it is an essential factor for developing acquired lymphedema in mouse hindlimb model.

CLINICAL RELEVANCE/APPLICATION

Secondary lymphedema in humans is a common consequence of axillary lymph node dissection (ALND) to treat breast cancer. To further investigation of the mechanism and treatment of lymphedema, a stable and reproducible animal model is needed. In our present study, radiation is an essential factor for developing acquired hindlimb lymphedema mouse model, which is helpful to develop a new hindlimb lymphedema mouse model.

SSA23-05 Localized Mild Hyperthermia for Radiosensitization in an Orthotopic Prostate Tumor Model in Mice

Sunday, Nov. 26 11:25AM - 11:35AM Room: S104A

Participants

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ABSTRACT

Purpose/Objective(s): The use of mild hyperthermia (41-43° C) as a modality for treatment of cancer is gaining interest. Studies have shown hyperthermia causes chemoradiosensitization and can be used to enhance the therapeutic effects of immunotherapy. Numerous in vivo studies have demonstrated hyperthermia-induced radiosensitization in subcutaneous tumor models; however, to our knowledge there are no studies that demonstrate the ability to deliver targeted hyperthermia from an external source to a deep-seated orthotopic tumor in the abdominal/pelvic region. Subcutaneous models lack the degree of translatability possessed by orthotopic models, as they don't represent the tumor microenvironments of the original tumor to the extent in which orthotopic tumors do. The objective of this preclinical study was to demonstrate the use of radiofrequency (RF) to induce mild hyperthermia in deep-seated tumors. In order to illustrate proof-of-concept, we developed and utilized an orthotopic intra-prostatatic tumor model in nude mice.Materials/Methods: The ventral lobes of the prostate of nude mice were injected with 1 x 105 PC3 cells transfected with luciferase through an open abdominal incision. Inoculation was confirmed with bioluminescence (BLI) imaging on day 3. BLI and ultrasound were used to track tumor growth and tumor volumes were calculated. RF-induced hyperthermia was delivered using the Oncotherm LAB EHY-100 device. The target temperature was 41° C as measured by a thermal probe placed in the rectum. RF was delivered through an electrode centered over the prostate and coupled to the skin via a thin layer of ultrasound gel in order to minimize dielectric inhomogeneities which can lead to eddy currents and thereby skin burns. The RF power was gradually increased from 0.3 watts until the desired temperature of 41° C was achieved. The treatment time per animal was 30 minutes. Results: Successful tumor inoculation was performed in all four mice as detected with bioluminescence. Average signal at confirmation was 4.25 x 107 photons/sec within the region of interest (ROI). Tumors were first detected by ultrasound on days 9-15. Average tumor

diameter at earliest detection was 4.8 mm (3.9-5.3 mm). Average tumor doubling time was 5 days. Hyperthermia was safely administered to the mice without toxicities. Fifteen to 45 minutes were needed to achieve the target temperature of 41° C.Conclusion: We were successful in establishing an orthotopic prostate tumor model in nude mice. Ultrasound and BLI both served as a reliable and efficient imaging modality to track tumor growth. To our knowledge, this is the first demonstration that radiofrequency can be used to safely and reproducibly deliver mild hyperthermia to a deep-seated tumor in the abdominal/pelvic region in a mouse model.

SSA23-07 Radiotherapy Induces Cell Arrest and Cell Apoptosis in Nasopharyngeal Carcinoma via the ATM and Smads Pathways

Sunday, Nov. 26 11:45AM - 11:55AM Room: S104A

Participants

MingYi Li, Guangzhou, China (*Presenter*) Nothing to Disclose Jinquan Liu, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Dongping Chen, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Yawei Yuan, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Zhouyu Li, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Nasopharyngeal carcinoma (NPC) is a common malignant neoplasm worldwide and harmful to human's health. Radiotherapy is commonly used in treating NPC and it induces immediate cell cycle arrest and cell apoptosis. However, the mechanism behind is recently maintained unknown. Evidences suggested the activation of Ataxia telangiectasia mutated (ATM) pathway and Smads pathway is the crucial mediator in the functions of radiotherapy.Materials/Methods: In this study, we carried out in vitro assays with CNE-2 cells and in vivo assays with nude mice in purpose of investigating the relationship between NPC and the ATM and Smads pathways. Results: The results suggested that radiation induced activation of ATM pathway that the expression of p-ATM, p-CHK1, p-CHK2 and p15 was increased; but it induced inhibition of the Smad3/7 cascade that the increased level of Smad7 suppressed the expression of p-Smad3. As a result, the cleaved Caspase3 was up-regulated expressed and CDC25A was down-regulated expressed and thereby cell cycle arrest and cell apoptosis occurred. On the other hand, the results also suggested the interaction between the ATM and Smads pathways. Activation of Smad3 can induce inhibition to ATM pathway and thereby the efficacy of radiation will be attenuated.Conclusion: In summary, we suggest that both ATM and Smad pathways contribute to the cell cycle arrest and cell apoptosis during radiation.

SSA23-08 Quantification of Cell-Free DNA in Breast Cancer Patients Receiving Adjuvant Radiotherapy

Sunday, Nov. 26 11:55AM - 12:05PM Room: S104A

Participants

Sangjune L. Lee, MD, MENG, Toronto, ON (*Presenter*) Nothing to Disclose Justin Burgener, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose Wei Xu, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose Kathy Han, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose Fei-Fei Liu, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose Scott Bratman, MD, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

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ABSTRACT

Purpose/Objective(s): Cell-free DNA (cfDNA) is released by healthy and malignant tissues into peripheral blood upon cell death. The concentration of cfDNA has been shown to vary in cancer patients, but the effects of radiotherapy (RT) are not known. The objective of this study was to serially evaluate cfDNA concentration from women receiving adjuvant RT for breast cancer. We hypothesized that cfDNA is released by damaged cells into the bloodstream resulting in an increase in total cfDNA concentration during adjuvant RT. Materials/Methods: Women receiving post-operative RT for breast cancer were enrolled in a prospective biomarker study in which phlebotomy was performed at 5 serial time points: baseline; 1 day following initiation of RT; 5 days following initiation of RT; at completion of RT; and 1 month following the completion of RT. We identified 4 patients treated with lumpectomy undergoing adjuvant RT who had provided all 5 blood samples. cfDNA was extracted from 1-2mL of peripheral blood plasma using the QIAamp Circulating Nucleic Acid Kit (Qiagen). The concentrations of double-stranded and single-stranded cfDNA at each time point were measured using Qubit kits (Life Technologies). Results: The 4 patients selected for analysis were diagnosed with ductal carcinoma in situ (N=3) or T1aN0M0 invasive lobular carcinoma (N=1). Mean age was 64 years (range: 56-75). Adjuvant RT consisted of intensity-modulated RT to a dose of 42.4Gy in 16 fractions, either to the right (N=2) or left (N=2) breast. None of the patients received chemotherapy or hormonal therapy. The lung volume receiving 20Gy or more (V20Gy) was 103-110cc for right- and 50-65cc for left-sided disease. 10cc of the heart received at least (D10cc) 0.7-0.8Gy for right- and 6.5-7.9Gy for leftsided disease. Double-stranded cfDNA concentration ranged from 1.7 – 13.3 ng per mL plasma (mean±SD 6.6±2.9). Single-stranded cfDNA concentration ranged from 8.6 – 54.4 ng per mL plasma (mean±SD 27.4±13.8). The concentrations of double-stranded and single-stranded cfDNA did not correlate with lung or heart dose and did not change significantly throughout the RT course (p>0.05 for all). Conclusion: The majority of plasma cfDNA exists as single-stranded DNA in patients undergoing adjuvant RT for breast cancer. The concentrations of double-stranded and single-stranded cfDNA did not change significantly throughout the RT course and did not correlate with doses to organs-at-risk.





SSA24

Vascular Interventional (IO-Lung Cancer)

Sunday, Nov. 26 10:45AM - 12:15PM Room: E350



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

Participants

Thomas-Evangelos G. Vrachliotis, MD, PhD, Athens, Greece (*Moderator*) Nothing to Disclose Hyun S. Kim, MD, New Haven, CT (*Moderator*) Nothing to Disclose

Sub-Events

SSA24-01 Towards Transpulmonary Chemoembolization with Degradable Starch Microspheres: Systematic Analysis of Local and Systemic Effects in a Porcine Model

Sunday, Nov. 26 10:45AM - 10:55AM Room: E350

Participants

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PURPOSE

To systematically investigate local and systemic effects of transpulmonary chemoembolization (TPCE) with degradable-starchmicrospheres (DSM) and doxorubicin. Long-term goal is to establish DSM-TPCE as treatment option for pulmonary malignancies.

METHOD AND MATERIALS

9 pigs underwent TPCE via a catheter placed in either the right or left lower-lobe-pulmonary-artery (LLPA) and bland embolization (TPE) of the contralateral LLPA. Pulmonary-arterial pressure, heart-rate and oxygenation were recorded immediately before and at 1, 3, 5 and 10 minutes after treatment. To investigate possible non-target embolization, animals underwent cerebral MRI. Animals were sacrificed after a contrast-enhanced chest CT for pathologic examination 12 hours (3), 24 hours (3) and 72 hours (3) after treatment.

RESULTS

Mean injected DSM-dose until stasis was similar in TPCE and TPE (4.2±1.4 vs. 4.5±1.5mL). Pulmonary-arterial pressure increased significantly 3 minutes after treatment (TPE: 17±5 vs. 27±7mmHg; TPCE: 22±6 vs. 36±8mmHg). No systemic cardiovascular effects, i.e. no change of heart-rate or oxygenation pre- vs. post TPCE or TPE were observed. No evidence of structural lung damage or permanent perfusion obstruction was observed on contrast-enhanced CT. No non-target embolization was found on cerebral MRI. Pathologic assessment revealed nonspecific local inflammation of the lung parenchyma, with increasing degree from 12 to 72h after treatment.

CONCLUSION

In this large-animal modal, TPCE and TPE appear feasible and safe. Only a clinical asymptomatic, mild increase in pulmonary-arterial pressure was observed. Non-target embolization to the brain did not occur. TPCE, as well as TPE did not cause significant damage to the normal lung-parenchyma.

CLINICAL RELEVANCE/APPLICATION

Transpulmonary chemoembolization is a treatment option for non-resectable pulmonary malignancies. It is minimally invasive and allows delivery of high chemotherapy doses to the tumor. The results of this preclinical study justify the conductance of TPCE for treatment in patients with malignant lung tumors to deliver higher doses of the chemotherapeutic agent to the tumor and meanwhile reduce side effects.

SSA24-02 To Evaluate the Clinical Utility of an Electromagnetic Navigation System for Performing Liver Biopsies with Real Time PET-CT and US Fusion

Sunday, Nov. 26 10:55AM - 11:05AM Room: E350

Stylianos Drisis, MD, Brussels, Belgium (*Presenter*) Nothing to Disclose Maxime Deforche, ARRT, Brussels, Belgium (*Abstract Co-Author*) Nothing to Disclose Marc P. Lemort, MD, Louvain La Neuve, Belgium (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the clinical utility of an electromagnetic navigation system for performing liver biopsies with real time PET-CT and US fusion.

METHOD AND MATERIALS

Fusion of PET-CT and US was performed during biopsies for 32 patients with liver metastasis. Twenty-four showed heterogeneous lesions (mixed SUV values with probably necrotic areas) and 8 showed homogenous lesions (smooth and homogeneous distribution of SUV values). Clinical impact of fusion was evaluated according to the following criteria: i) re-planification of target after fusion ii) localization- visualization of the lesion. iii) Success of the biopsy.

RESULTS

For the group of heterogeneous lesions, fusion has changed the target of the radiologist in all 24 cases aiming intra-tumoral regions of high FDG uptake. For the homogeneous lesions group, in 6 cases the fusion helped to better visualize the lesion either because of low US contrast (2 cases) either because of localization in the liver dome (4 cases). All biopsies were successful with sufficient material for sequencing.

CONCLUSION

Real time fusion of PET-CT and US has facilitated the biopsy for all 23 heterogeneous lesions and for 6 out of 8 homogeneous lesions.

CLINICAL RELEVANCE/APPLICATION

Using functional information during liver biopsies can facilitate the interventional radiologist by targeting only the FDG active therefore highly cellularised regions of the tumor. Moreover it increases radiologists' confidence with better visualization and localization of the lesion especially in difficult liver regions such as the dome. In the future functional imaging will be more involved in the planification of percutaneous biopsies.

SSA24-03 Ablation Therapy of Non-Colorectal Cancer Lung Metastases: Retrospective Analysis of Tumor Response post Laser-Induced Interstitial Thermotherapy (LITT) Radiofrequency Ablation (RFA) and Microwave Ablation (MWA)

Sunday, Nov. 26 11:05AM - 11:15AM Room: E350

Participants

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PURPOSE

To retrospectively compare the local tumor response and survival rates in patients with non-colorectal cancer lung metastases post ablation therapy using laser-induced thermotherapy-(LITT), radiofrequency ablation-(RFA) and microwave ablation-(MWA).

METHOD AND MATERIALS

Retrospective analysis of 175 CT-guided ablation sessions performed on 109 patients (43 males and 66 females, mean age: 56.6years). 17 patients with 22 lesions underwent LITT treatment (tumor size: 1.2-4.8cm), 29 patients with 49 lesions underwent RFA (tumor size: 0.8-4.5 cm) and 63 patients with 104 lesions underwent MWA treatment (tumor size: 0.6-5 cm). CT-scans were performed 24-hours post therapy and on follow-up at 3, 6, 12, 18 and 24 months.

RESULTS

The overall-survival rates at 1-,2-,3- and 4-year were 93.8%,56.3%,50.0% and 31.3% for patients treated with LITT,81.5%,50.0%,45.5% and 24.2% for patients treated with RFA and 97.6%, 79.9%,62.3% and 45.4% for patients treated with MWA respectively. The mean survival-time was 34.14 months for MWA, 34.79 months for RFA and 35.32 months for LITT. In paired comparison a significant difference could be detected between MWA versus RFA (p=0.032). The progression-free survival showed a median of 23.49 ± 0.62 months for MWA,19.88 months ±2.17 months for LITT and 16.66 ± 0.66 months for RFA(p=0.048). The lowest recurrence rate was detected in lesions ablated with MWA (7.7%; 8 of 104 lesions) followed by RFA (20.4%; 10 of 49 lesions) and LITT (27.3%;6 of 22 lesions) p- value of 0.012. Pneumothorax was detected in 22.16% of MWA ablations, 22.73% of LITT ablations and 14.23% of RFA ablations.

CONCLUSION

LITT, RFA and MWA may provide an effective therapeutic option for non-colorectal cancer lung metastases with an advantage for MWA regarding local tumor control and progression-free survival rate.

CLINICAL RELEVANCE/APPLICATION

LITT, RFA and MWA have a therapeutic potential regarding local tumor control and progression-free survival rate patients with noncolorectal cancer lung metastases .

SSA24-04 Image Guided Tumor Biopsies in a Prospective Molecular Triage Study (MOSCATO 01): What Are the Risks?

Sunday, Nov. 26 11:15AM - 11:25AM Room: E350

Participants

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PURPOSE

To describe complications of percutaneous image-guided biopsies for genomic analysis in cancer patients, their management and to determine pre-procedural risk factors.

METHOD AND MATERIALS

Data from biopsies performed at a single center in the prospective MOSCATO-01 clinical trial were recorded between November 2011 and March 2016.Data included patient demographics, previous therapies, and biology reports.Tumor and procedure characteristics were evaluated.Complications, their management, and tumor cellularity were recorded.Univariate and multivariate analysis was performed to determine predictive factors for complications.

RESULTS

Seven-hundred and forty biopsies were performed on 689 patients, with a mean of 4 samples per biopsy. Biopsies were performed on tumors in the liver (n:=:297), lung (n:=:184), lymph nodes (n:= 121), bone (n:=:14), or another site (n:=:122) under CT (31%) or US guidance (69%). Seventy patients (10%) experienced a complication including 67% grade 1, 23% grade 2, 10% grade 3, 0% grade 4 and the mortality rate was 0%. Most common complications were pneumothorax (61%), hemorrhage (24%) and pain (7%) and none was life-threatening. Among 10 hemorrhagic complications, 3 required trans-arterial embolization. Tumor location (lung), renal function (creatinine as a continuous variable), lesion size (as a continuous variable), depth (distance to pleura for lung biopsies, as a continuous variable) and prone position, were found as predictive factors for complication in univariate analysis.By multivariate analysis:only tumor location (lung vs other) OR=1.26 [1.18-1.34], and depth for lung biopsies OR=1.26 [1.18-1.34], were significant risk factors in our population.Biopsies where contributive for genomic analysis in 88% of cases.

CONCLUSION

Percutaneous image-guided core-needle biopsies are feasible and safe in cancer patients for molecular screening. The different risk factors identified did not increase mortality or preclude the successful acquisition of useful tissue for genomic analysis.

CLINICAL RELEVANCE/APPLICATION

umor biopsies are key for genomic analysis to drive targeted therapies matching specific molecular alterations. Percutaneous imageguided biopsies are feasible and safe.

SSA24-05 Feasibility Study of CT-Guided Needle Insertion Using Stereotaxic Unit for Lung Biopsy

Sunday, Nov. 26 11:25AM - 11:35AM Room: E350

Participants

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PURPOSE

Durnoce of this study is to evaluate accuracy and feasibility of CT-quided mont-assisted needle placement of lung lesion

רעו אספר טו גרווס אנעע וס גט פעמועמנים מכנעו מנע ופמטוטווגע טו כו - שעועפע, וטאטנ-מסטונע וופפעום אומנפוופוג טו ועווע ופטוטו

METHOD AND MATERIALS

The robot system including 5-axis robot arm, a mobile platform with motor controllers, dedicated workstation for planning of needle path, and the navigation system (Polaris Spectra®; NDI, Canada) was developed. It provides useful functions including such as needle path planning, respiration monitoring, laser guidance, automatic needle positioning and guiding. To evaluate the feasibility and accuracy of the system in needle placement, patient with lung lesions requiring biopsy were included. Under CT guidance. CT scan was performed to localize the target lesion and the CT data was transferred to the system. The spatial relation between patient and the robot system was registered with navigation system. After planning the needle path on workstation, the spatial information was translated to the robotic system. The robot system automatically angulates the needle to the target and depth of insertion is determined. Total of 21 needle insertion trials were performed. Using the CT images after the insertion, distance between the target and actual needle tip and angle between preplanned route and actual needle pathway were measured.

RESULTS

The distances between the target and the needle tip for robot assisted was 8.13±5.2mm. Angular deviation was 4.49±2.86°. Procedure was 17m45s±4m36. Since additional CT scanning was performed. Small amount of pneumothorax occurred in three patients, but no additional procedures were needed. Small amount of hemoptysis occurred in one patient.

CONCLUSION

Developed robot system provides comparable accuracy of CT guided needle placement for lung lesion to conventional procedure.

CLINICAL RELEVANCE/APPLICATION

Compared with conventional biopsy procedures, it is expected to use tools that make it easier to perform biopsy by lowering barriers to entry by non-experts.

SSA24-06 Meteorological Conditions and Incidence of Pneumothorax and Chest Tube Placement after Percutaneous CT-Guided Lung Biopsy

Sunday, Nov. 26 11:35AM - 11:45AM Room: E350

Participants

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PURPOSE

Previous studies suggest that changes in atmospheric pressure may correlate with the incidence of idiopathic spontaneous pneumothorax. The aim of our study was to retrospectively evaluate the meteorological variables that may influence rates of pneumothorax and chest tube placement after percutaneous CT-guided lung biopsy, in particular the atmospheric pressure (P) and temperature (T).

METHOD AND MATERIALS

We analyzed 338 percutaneous CT-guided lung biopsies performed with 20-gauge coaxial cutting needles between December 2011 and May 2014. For each day within the period analyzed, the mean P (mP), as well as mean (mT), maximal, and minimal temperatures, were recorde. To evaluate the influences of pressure changes, differences in mP were calculated from one day before and one day after the procedure. We also recorded the humidity and presence or absence of special weather conditions (thunderstorms, snow, and rainfall). Unequal variance t test was used to measure the degree of association. P-value <0.05 was considered significant.

RESULTS

The overall incidence of pneumothorax was 34.0% (115/338), with 26.1% (30/115) requiring chest tube placement (8.9% of all procedures). The average mP and mT were 29.9 ± 0.2 inches of mercury (inHg) and $58.2 \pm 17.01^{\circ}$ F, respectively, during the study period. The mP did not correlate significantly with post-biopsy pneumothorax (p=.277) or chest tube placement (p=.767). There was also no correlation between the mT and post-biopsy pneumothorax (p=.619) or chest tube placement (p=.987). Pressure changes, humidity, and special weather conditions did not significantly influence the occurrence of pneumothorax or chest tube placement rate.

CONCLUSION

Although meteorological factors may impact incidence of spontaneous pneumothorax, no correlation was found in our study between these factors and incidences of post-biopsy pneumothorax and chest tube placement. Further studies could confirm these findings with a larger study population, as well as investigate the impact of more rapid and profound pressure changes, such as in the setting of air travel, on these complications.

CLINICAL RELEVANCE/APPLICATION

Routine weather fluctuations do not impact the incidence of post-biopsy pneumothorax, despite correlations with spontaneous pneumothorax, and should not impact procedure planning.

SSA24-07 Percutaneous Cryoablation of Metastatic Lung Tumors: High Efficacy with Low Morbidity

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PURPOSE

To assess technical feasibility, efficacy and complication rates of CT guided cryoablation of metastatic lung tumors in multiple locations.

METHOD AND MATERIALS

CT fluoroscopic-guided percutaneous cryoablation was performed in 185 procedures on 252 metastatic lung tumors in 104 patients. Tumor and ablation volumes, location, abutting vessels >3mm, recurrences, and PFT's were reviewed for all patients. Complications were graded by the National Institutes of Health, Common Terminology of Complications and Adverse Events 4.0 (CTCAE).

RESULTS

All procedures were performed with conscious sedation. Mean FEV1 and DLCO2 were 86.6% (32-144%) and 76.9% (29-110%), respectively. Overall tumor and ablation mean size was 2.0 cm (0.5 - 12.3 cm) and 4.1 cm (2.1-12.8), respectively. Total major complication rates were only 3.7% (7/185), and were not statistically significant between tumors <=3 cm (2.8% N=4/147) vs >3cm (7.9% N=3/38) (p>0.1). No statistical significance was noted for major complications with central tumors or major vessel proximity (p>0.1). A pneumothorax occurred in 88 procedures (47.6%) of which 43 (23.2%) were self-limited resolving without intervention and 42 (22.7%) requiring immediate suction or short term chest tube (< 24hrs). Only 3 (1.6%) procedures required prolonged chest tube (>grade 3). Recurrence rates of 5.2% (13/252) were greater in tumors 3.2% (7/100) compared with peripheral tumors 3.9% (6/152) this was not statistically significant (p> 0.1).

CONCLUSION

CT guided percutaneous cryoablation of lung metastasis provides a low morbidity alternative with one of the highest efficacy rates noted in literature, regardless of tumor size. Tumor size and location does not significantly affect complication rates.

CLINICAL RELEVANCE/APPLICATION

Appropriately delivered thoracic metastasis cryoablation is affected by tumor size yet still produces very low recurrence and complication rates.

SSA24-08 Lung Metastases: Role of Transpulmonary Chemoembolization (TPCE) in a Palliative or Neoadjuvant Intention

Sunday, Nov. 26 11:55AM - 12:05PM Room: E350

Participants

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PURPOSE

To evaluate tumor response, local tumor control and survival after the treatment of secondary lung metastases using transpulmonary chemoembolization (TPCE) in palliative and neoadjuvant intention.

METHOD AND MATERIALS

Between 08/04 and 11/16 142 patients (mean 56.6±13.5 years; 73 females, 69 males) with unresectable lung metastases underwent repetitive TPCE (mean: 5.7±2.8 sessions). Primary tumors were colorectal carcinoma (n=58), breast cancer (n=27), sarcoma (n=13), renal cell carcinoma (n=8) and others (n=36). Bilateral lung involvement occurred in 79.6% of patients (median number of lung nodules: 10). 50 patients who underwent subsequent ablation either for all lesions (complete) or some lesions (incomplete) were included. Preinterventional MRI and postinterventional CT was performed after each session. Response was assessed according to the RECIST criteria. Local tumor progression and overall survival were analyzed using Kaplan-meier and Cox hazard regression.

RESULTS

After evaluation of tumor response partial response (PR) was achieved in 11.3% (n=16), stable disease (SD) in 66.2% (n=94) and progessive disease (PD) in 22.5% (n=32). Mean survival time and time to progression were 24.3 months and 7.5 months respectively from the date of first intervention. The longest mean survival time was recorded in breast cancer patients with 28.4 months followed by colorectal cancer with 25 months. In the pallilative group mean survival was 19.4 months vs 30.4 months in the neoadjuvant group with subsequent ablation.

CONCLUSION

TPCE has the potential to improve local tumor control and to prolong survival with a neoadjuvant potential when ablation therapies are combined.

CLINICAL RELEVANCE/APPLICATION

Combined TPCE and ablation therapies can improve local tumor control and survival vs. TPCE alone.

SSA24-09 Visible Beads for Pulmonary Artery Embolization (PAE) - Proof of Principle

Sunday, Nov. 26 12:05PM - 12:15PM Room: E350

Participants

Christof M. Sommer, MD, Heidelberg, Germany (Presenter) Research Grant, AngioDynamics, Inc; Research Grant, Terumo Corporation; Research Grant, PharmaCept GmbH; Technical support, BTG International Ltd; Technical support, Boston Scientific Corporation; Technical support, Siemens AG; Technical support, Medtronic plc; Alexander Harms, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose Thuy D. Do, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose Theresa L. Gockner, MD. Mainz, Germany (Abstract Co-Author) Nothing to Disclose Christopher L. Schlett, MD, MPH, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose Dominik Vollherbst, MD, Heidelberg, Germany (Abstract Co-Author) Grant, AngioDynamics, Inc Philippe L. Pereira, MD, Heilbronn, Germany (Abstract Co-Author) Research Consultant, Terumo Corporation; Speaker, AngioDynamics, Inc; Speaker, Terumo Corporation; Advisory Board, Siemens AG; Advisory Board, Terumo Corporation; Board, Bayer AG; Advisory Board, Medtronic plc; Support, Bracco Group; Support, PharmaCept GmbH; Support, Terumo Corporation; Support, Siemens AG; Support, Novartis AG; Support, Cook Group Incorporated; Research Grant, Biocompatibles International plc; Research Grant, Siemens AG; Research Grant, Terumo Corporation; Research Grant, BTG International Ltd Manfred Jugold, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose Arne Warth, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose Goetz M. Richter, MD, PhD, Heidelberg, Germany (Abstract Co-Author) Research Grant, CeloNova BioSciences, Inc; Research Grant, Boston Scientific Corporation; Research Grant, Siemens AG; Research Grant, Medtronic plc Hans-Ulrich Kauczor, MD, Heidelberg, Germany (Abstract Co-Author) Research Grant, Siemens AG; Research Grant, Bayer AG; Speakers Bureau, Boehringer Ingelheim GmbH; Speakers Bureau, Siemens AG; Speakers Bureau, Koninklijke Philips NV; Speakers Bureau, Bracco Group; Speakers Bureau, AstraZeneca PLC; Paul G. Flechsig, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose

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PURPOSE

To analyze the degree of x-ray visibility of different types of microspheres for pulmonary artery embolization (PAE).

METHOD AND MATERIALS

Three different types of microspheres were analyzed: narrow-size calibrated 250µm-Embozene[™], narrow-size calibrated 250µm-VISIBLE, and broad-size calibrated 100-300µm-DCBead[™]. Initially, in-vitro imaging applying MicroCT and human-scale CT was performed. Subsequently, 6 pigs underwent PAE of peripheral lung segments using the different types of microspheres. Thereby, the embolization endpoint was defined as delivery of a pure microsphere volume of 0.5 ml in each embolization position. After PAE, in-vivo human-scale DynaCT and CT followed, and subsequently sacrifice, lung harvest and preparation of paraffin blocks of the embolized lung segments. Representative paraffin blocks underwent ex-vivo imaging applying MicroCT. The study endpoint included the degree of x-ray visibility.

RESULTS

In-vitro imaging applying MicroCT and human-scale CT identified the lowest x-ray visibility for 250µm-Embozene[™], the highest xray visibility for 250µm-VISIBLE, and a lack of x-ray visibility for 100-300µm-DCBead[™]. Ex-vivo imaging applying MicroCT identified the lowest x-ray visibility for 250µm-Embozene[™], the highest x-ray visibility for 250µm-VISIBLE, and a lack of x-ray visibility for 100-300µm-DCBead[™]. Angiography after PAE documented occlusion of sub-segmental arteries for all types of microspheres. In-vivo imaging applying human-scale DynaCT and CT identified the highest x-ray visibility for 250µm-VISIBLE, and a lack of x-ray visibility for 250µm-Embozene and 100-300µm-DCBead[™].

CONCLUSION

In this study, PAE with 250µm-Embozene[™], 250µm-VISIBLE, and 100-300µm-DCBead[™] results in a different degree of x-ray visibility of the microspheres.

CLINICAL RELEVANCE/APPLICATION

Potential clinical advantages of PAE applying 250μ m-VISIBLE include better treatment control due to the high degree of x-ray visibility of the microspheres, and - when compared with $100-300\mu$ m-DCBeadTM - controlled occlusion of arteries with a size closely corresponding to the nominal microsphere size (bronchiolus-associated arteries).







SSA25

Vascular Interventional (Ablation and Image Guided Interventions)

Sunday, Nov. 26 10:45AM - 12:15PM Room: E352

IR VA

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

Participants

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Sub-Events

SSA25-01 CT-Guided 125I Brachytherapy for Locally Recurrent Nasopharyngeal Carcinoma

Sunday, Nov. 26 10:45AM - 10:55AM Room: E352

Participants

Huzheng Yan I, PhD,PhD, Guangzhou, China (*Presenter*) Nothing to Disclose Fujun Zhang, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The study evaluated the feasibility, clinical effectiveness, and quality of life of computed tomography (CT)-guided 1251 brachytherapy for locally recurrent nasopharyngeal carcinoma (NPC).

METHOD AND MATERIALS

We recruited 81 patients diagnosed with locally recurrent NPC after previous radiotherapy with or without chemotherapy. Thirtynine patients received 125I brachytherapy (group A) and 42 received re-irradiation (IMRT, group B). The evaluated outcomes were local control, complications, and quality of life. Cox proportional hazards regression analysis was used to compare local tumor progression-free survival (LTPFS) and overall survival (OS) in the two treatment groups.

RESULTS

The median follow-up was 30 months (range, 5-68 months), median LTPFS was 21 in group A and 17 months in group B. The 1-, 2-, and 3-year OS in group A were 84.6%, 51.3%, 30.7%, and 85.7%, 50.0%, and 32.6% in group B. In group A, 10/39 patients (25.6%) experienced at least one >=grade III complication; no grade V complications occurred. In group B, 28/42 (66.7%) experienced at least one >=grade III complication and 6/42 (14.3%) died of severe grade V complications. No significant between-group difference existed in the Quality of Life score on the EORTC QLQ-H&N35 questionnaire before treatment. In group A, quality of life was significantly improved after treatment; but did not improve, or even deteriorated in group B.

CONCLUSION

125I brachytherapy was a feasible, safe, and effective treatment for locally recurrent NPC. 125I brachytherapy significantly reduced complications caused by re-irradiation and improved patients' quality of life.

CLINICAL RELEVANCE/APPLICATION

enhanced MRI were obtained for the evaluation of curative effect at 1 month after treatment and then every 3 months.

SSA25-02 A Prospective Comparative Study on the Application of Microcoil and Hookwire For Localization of Small Pulmonary Nodules

Sunday, Nov. 26 10:55AM - 11:05AM Room: E352

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PURPOSE

To compare the efficacy and safety of preoperative localization technique using microcoil and hookwire for small pulmonary nodules.

METHOD AND MATERIALS

Fifty-four patients with 54 pulmonary lesions for preoperative localization enrolled in this study from October 2015 to March 2017. Inclusion criteria were as follows: (1) video-assisted thoracoscopic surgical (VATS) intended;(2) radiological features match :1) pulmonary nodules <20 mm;2) lesions locating in the 1/3 peripheral part of the lung with feasibility of wedge resection or segmentectomy;3) without pleural retraction sign; (3)agree to be enrolled in this study and sign informed consent. All the patients

were randomly assigned to two groups. The 27 patients in Group A underwent CT-guided percutaneous localization procedure with microcoil on the day of operation; the other 27 patients in Group B underwent CT-guided percutaneous localization procedure with hookwire on the day of surgery. The primary outcomes were procedure success rate and complication rate.

RESULTS

VATS were successfully performed in all the cases, with no conversion to thoracotomy. The procedure success rate was 96.2% (26/27) in Group A and 92.6% (25/27) in Group B (P>0.05). The complication rate was 18.5% (5/27) in Group A; asymptomatic pneumothoraces occurred in 3 patients and mild pulmonary hemorrhage occurred in 2 patients. The complication rate was 51.8% (14/27) in Group B; asymptomatic pneumothoraces occurred in 11 patients and mild pulmonary hemorrhage occurred in 2 patients and chest pain requiring medical intervention occurred in 1 patient(P<0.05).

CONCLUSION

Both microcoil and hookwire have been proved to be effective in preoperative CT-guided percutaneous localization for small pulmonary nodule. Localization procedures with microcoil were associated with fewer complications and more advantages in clinical application.

CLINICAL RELEVANCE/APPLICATION

Localization procedures with microcoil were associated with fewer complications and more advantages in clinical application and is recommended as the optimal method.

SSA25-03 Innovative Technique for CT-Guided Lung Nodule/Tumor Marking Prior to Surgery: High Efficacy and Low Complication Rates

Sunday, Nov. 26 11:05AM - 11:15AM Room: E352

Participants

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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

24 CT guided lung nodule localization procedures were performed on 24 nodules in 24 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 the perinodular location under CT-guidance with a 19 g trocar needle. Post procedure CT was performed and the patient was transferred to surgery.

RESULTS

Accurate perinodular CT- guided needle trocar placement was achieved in all marking procedures. Increased perinodular consolidation was demonstrated in all patients on the post procedural 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. A second patient developed a tiny pneumothorax which was managed with non-rebreather oxygen mask. There was no noted bleeding or hemoptysis in any patient. Methylene blue/ collagen solution was readily visible by the thoracic surgeon in 23 patients (94%). In one patient, the methylene blue/ collagen was not visualized by the surgeon or present in specimen, although post-marking CT demonstrated perinodular consolidation. Of the 23 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 low-cost, 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.

SSA25-04 Intraarterial Chemoperfusion (IACP) for Treatment of Irresectable Chest Wall or Lymph Node Recurrence of Breast Cancer Not Amenable to Radiation Therapy

Sunday, Nov. 26 11:15AM - 11:25AM Room: E352

Participants

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PURPOSE

About 10% of breast cancers recur locally after mastectomy. Depending on the type of prior radiotherapy, chest wall recurrences are not amenable to resection or radiation therapy. For these patients, intraarterial chemoperfusion (IACP) is a treatment option. We report on our long-term experiences with IACP depending on type of breast cancer (luminal vs. basal).

METHOD AND MATERIALS

11 women (32-84 years) with chest-wall (n=3) or loco-regional lymph-node recurrence (n=7) or both (n=1), of basal-type (triplenegative) breast cancer in 4, and of luminal-A/B-type in 7. IACP was performed superselectively via the internal thoracic artery, or an axillary artery branch using a perfusor-guided infusion of 30 mg mitoxantrone via mirocatheter. IACP was repeated every 3 weeks depending on tumor response and leukocyte-count. MRI/CT was performed prior to each IACP-session and every 3 months during follow-up. Local control was defined as CR, PR, or SD.

RESULTS

Five patients underwent 4 IACP-sessions, 2 patients had 3, and 4 had a single IACP-session. CR was achieved in 4/11, PR in 4/11, SD in 3/11, and PD in 0/11, yielding a local-control-rate of 11/11 (100%). Of the 8 responders, 6 (75%) were Luminal-A/B-type, of the 3 non-responders, 2 (66.7%) were basal-type cancers. 4/8 responders demonstrated long-term (>36 months) CR; all four had luminal-A/B-type. 2/3 non-responders died <2 months after therapy initiation. One patient experienced a major side-effect (cardiac-decompensation); minor side-effects occurred in 3/11 patients.

CONCLUSION

For patients with unresectable, locally recurrent luminal-A/B-type breast cancers not amenable to radiation therapy, IACP can offer long-term local-control, or even complete remission, with minimal side effects.

CLINICAL RELEVANCE/APPLICATION

IACP is a valuable treatment option for patients with local recurrent luminal-A/B-type breast cancer.

SSA25-05 Prospective Clinical Trial for Uterine Adenomyosis Using Portable Ultrasound-guided High Intensity Focused Ultrasound: Interim Results

Sunday, Nov. 26 11:25AM - 11:35AM Room: E352

Participants

Jae Young Lee, MD,PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose Hyun Hoon Chung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Maria Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Soo Yeon Kang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Keonho Son, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Joon Koo Han, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Employee, Alpinion Medical Systems Co, Ltd

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PURPOSE

To investigate the efficacy and safety of a new portable compact ultrasound-guided high intensity focused ultrasound (USgHIFU) with advanced targeting and beam steering technology for the treatment of uterine adenomyosis

METHOD AND MATERIALS

This prospective study was approved by the institutional review board, and informed consent was obtained from all participants. Fifty-one uterine adenomyoses from 51 patients (mean age, 44.1 ± 4.2 years) were included. All patients were treated with HIFU with 3D electronic steering. MR imaging studies were performed before HIFU, immediately after HIFU, and 1 month, and 3 months. The non-perfused volume ratio (NPVR), Adenomyosis volume shrinkage rate (AVSR), dysmenorrhea improvement index (1, complete relief; 3, minor relief; 5, exacerbated pain), treatment time and safety were analyzed.

RESULTS

The mean volume of the treated uterine adenomyoses was 125.0 ± 129.2 cm3. The mean NPVR on the immediate post-HIFU MR imaging was $59.6 \pm 36.1\%$. The mean AVSR was 17.8% at 1 month, and 36.1% at 3 months after HIFU treatment. The mean time taken to treat was 94.6 ± 33.7 minutes per patient. Complete relief of dysmenorrhea was identified in 15.2% and 34.2% of treated patients, 1 month and 3 months after HIFU treatment, respectively. The mean dysmenorrhea improvement index was 2.5 and 2.1, 1 month and 3 months after HIFU treatment, respectively. No significant symptoms related to safety or complications occurred

CONCLUSION

The interim results of our clinical trial showed that USgHIFU may be effective and safe for the treatment of uterine adenomyosis.

CLINICAL RELEVANCE/APPLICATION

Ultrasound-guided HIFU with advanced functions may be effective and safe for the treatment of uterine adenomyosis.

SSA25-06 Flow Mediated Dilatation (FMD) Assessment via an MRI Integrated Signal Intensity (IntSI) Approach: A Comparison with Ultrasound

Sunday, Nov. 26 11:35AM - 11:45AM Room: E352

Participants Omodele A. Olowoyeye, MBBS, MSc, Toronto, ON (*Presenter*) Nothing to Disclose

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PURPOSE

To demonstrate that flow mediated dilatation using an integrated signal intensity MRI approach for serial area measurements is more repeatable than ultrasound based flow mediated dilatation.

METHOD AND MATERIALS

An integrated signal intensity MRI approach was used to perform flow mediated dilatation (MRI-FMD) in 19 healthy volunteers. The test-retest repeatability of popliteal MRI-FMD using the integrated signal intensity (IntSI) technique was compared with that of brachial and popliteal ultrasound FMD.

RESULTS

There was moderate agreement between brachial US-FMD and popliteal US-FMD (r: 0.59). The mean difference between the baseline areas of the popliteal artery using MRI versus US was $4.76 \pm 5.19 \text{ mm2}$, which is a difference of 19 % relative to the US baseline area. The mean difference between popliteal US-FMD and MRI-FMD was 5.07%. The within subject coefficient of variability of the popliteal MRI-FMD technique at 17% was comparable with both the brachial ultrasound and popliteal ultrasound FMD techniques (16 % and 18% respectively).

CONCLUSION

MRI-FMD using the IntSI technique provides an alternative method of measuring macrovascular endothelial function.

CLINICAL RELEVANCE/APPLICATION

Ultrasound has high temporal and spatial resolution so it is suitable for detecting transient changes in the vessel calibre during FMD. However, it is operator dependent, therefore may not be suitable for multicenter studies. MRI on the other hand is less operator dependent so can be used for multicenter studies. Current MRI techniques for measuring FMD require high resolution because the luminal area is measure by pixel counting, but there is a trade off between spatial and temporal resolution, which limits the temporal sampling frequency. FMD assessment using the integrated signal intensity approach provide a means of obtaining serial measurements of the artery during the vasodilatory response.

SSA25-07 Long-Term Outcome of RF-Ablation for Non-Resectable Recurrence of Colorectal Liver Metastases in the Liver Remnant after Prior Hepatic Resection

Sunday, Nov. 26 11:45AM - 11:55AM Room: E352

Participants

Markus Zimmermann, MD, Aachen, Germany (*Presenter*) Nothing to Disclose Maria Konsoula, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose Maximilian F. Schulze-Hagen, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose Martin Liebl, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose Federico Pedersoli, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose Peter Isfort, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose Christiane K. Kuhl, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose Philipp Bruners, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the outcome of patients treated with radiofrequency ablation (RFA) for non-resectable hepatic recurrence of colorectal liver metastases (CRLM) in patients initially treated surgically with curative intent.

METHOD AND MATERIALS

19 consecutive patients (10 male, 9 female) who underwent CT-guided RFA for recurrent, non-resectable CRLM of the liver remnant after hepatic resection were included. Patients with a maximum of three metastases measuring up to 3 cm and without relevant extrahepatic disease were considered candidates for RFA. In addition to local ablation, all patients received adjuvant chemotherapy and were re-treated by local ablation during the follow-up period whenever appropriate. Patient and treatment related data were analyzed retrospectively; progression-free-survival (PFS) and overall survival (OS) rates after the first RF-ablation were determined. Median follow-up was 21 months (range 12-80 months).

RESULTS

Mean time interval between hepatic resection and percutaneous ablation of hepatic tumor recurrence was 7.6 +/-7.5 (SD) months. In 3 of the 19 patients, tumor recurred at the surgical resection margin, the remaining 16 patients were treated for metastases that had recurred elsewhere in the liver remnant. After RFA, median PFS was 7 months (n=19, range 1-81 months). The 1-year-OS-rate was 100% (19/19), the 3-year-OS-rate was 50% (n=6/12 - 7 patients had a follow-up of less than 3 years) and the 5-year-OS-rate was 17% (n=2/12). 10 patients developed recurring intrahepatic disease after treatment with RFA. Of these 10 patients, one patient developed local tumor recurrence at the ablation site, while the remaining 9 patients developed new metastases elsewhere in the liver. Minor peri-interventional complications occured in two patients and included segmental cholestasis adjacent to the ablation zone in one patient and a small basal pneumothorax and minor hemorrhage into the ablation zone in one other patient. Both patients were asymptomatic and managed conservatively.

Overall survival rates support the use of secondary RF-ablation for treatment of hepatic recurrence of non-resectable CRLM after initial hepatic resection.

CLINICAL RELEVANCE/APPLICATION

In patients with local intrahepatic recurrence after hepatic surgery for CRLM, RFA should be an integral part of a multimodality treatment regimen.

SSA25-08 Utilization of Interventional Oncologic Therapies for Patients Referred to a Primary Liver Tumor Board at a Tertiary Care and Liver Transplant Center

Sunday, Nov. 26 11:55AM - 12:05PM Room: E352

Participants

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- Orhan S. Ozkan, MD, Madison, AL (Abstract Co-Author) Nothing to Disclose
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PURPOSE

To characterize the utilization of interventional oncologic (IO) therapies for patients referred to a primary liver tumor board at a tertiary care and liver transplant center.

METHOD AND MATERIALS

A retrospective chart review was performed on all patients referred to a primary liver tumor board at a single tertiary care and liver transplant center from January 1, 2013 to December 31, 2015. The board is a multidisciplinary board consisting of diagnostic and interventional radiologists, transplant surgeons, surgical oncologists, gastroenterologists, hepatologists, pathologists, and medical and radiation oncologists. The number and dates of the following treatments were noted: ablation, radioembolization (Y90), transarterial chemoembolization (TACE), bland embolization (TAE), systemic therapy, surgery/resection, liver transplantation, radiation, or nothing/palliative care. Interventional oncologic therapies included ablation, Y90, TACE and TAE. The number of patients with treatable lesions (primarily HCC or cholangiocarcinoma) undergoing each type of treatment were calculated, as was the percentage of patients undergoing IO therapies and the mean number of IO treatments per patient.

RESULTS

Of the 729 patients referred to the liver tumor board, 299 had at least one treatable liver lesion and underwent a total of 523 oncologic treatments. The remainder had indeterminate lesions, benign tumors or no evidence of disease. Of the 299 patients with treatable lesions, 74% (221/299) underwent at least one IO therapy and 70% (208/299) underwent an IO therapy as first line treatment. The mean number of IO treatments was 1.2 per patient (range, 1-5) for a total of 368 IO treatments performed. The most frequently performed IO therapy was thermal ablation (48% of all IO treatments), followed by TACE (25%), Y90 (20%), and TAE (7%). Ablation was also the most common IO treatment used as first line therapy (53%), followed by Y90 (23%), TACE (18%), and TAE (6%). The most frequently used non-IO treatments were surgical resection and liver transplantation (12%, 37/299 patients each).

CONCLUSION

Interventional oncology plays a pivotal role in managing patients with primary liver tumors with the majority of patients with treatable lesions undergoing at least one IO therapy.

CLINICAL RELEVANCE/APPLICATION

Interventional oncologists must play an active role in multidisciplinary groups and tumor boards that determine patient referrals and treatment pathways.

SSA25-09 Microwave Ablation and Radiofrequency Ablation for Treatment of Hepatocellular Carcinoma: Result of a Prospective Randomized Controlled Trial

Sunday, Nov. 26 12:05PM - 12:15PM Room: E352

Participants

Naik Vieti Violi, Lausanne, Switzerland (*Presenter*) Nothing to Disclose Rafael Duran, MD, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose Boris Guiu, MD, Dijon, France (*Abstract Co-Author*) Nothing to Disclose Christophe Aube, MD, PhD, Angers, France (*Abstract Co-Author*) Speaker, Supersonic Imagine; Consultant, Siemens AG; Support, General Electric Company; Support, Guerbet SA; Jean P. Cercueil, MD, Dijon, France (*Abstract Co-Author*) Nothing to Disclose Isabelle Pache, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose Pierre Deltenre, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose Jean-Francois Knebel, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose Alban L. Denys, MD, Lausanne, Switzerland (*Abstract Co-Author*) Consultant, BTG International Ltd Grant, BTG International Ltd Consultant, Terumo Corporation

PURPOSE

In a prospective randomized controlled multi-centric study, we compared rate of local tumor progression and survival in patients with chronic liver disease with hepatocellular carcinoma (HCC) <4cm treated either by microwave ablation (MWA) or by radiofrequency ablation (RFA).

METHOD AND MATERIALS

Patients with chronic liver disease having HCC with <=3 lesions of <=4cm, BCLC stage A, not eligible for surgery were prospectively randomized from 2011 to 2015. Final RFA group (open arm) consisted in 73 patients with 104 lesions ablated (11 females, 53 patients with Child-Pugh A) and final MWA group (Acculis) consisted in 71 patients with 98 lesions ablated (12 females, 57 patients with Child-Pugh A). Rate of local tumor progression (LTP) at two years of follow-up in intention-to-treat analysis was the primary outcome. Time to progression (TTP), survival, incomplete treatment rate and safety constituted the secondary outcomes. Groups were compared using unpaired T-test and Chi-square test depending of the type of data. Survival analysis was made using Kaplan-Meier curves.

RESULTS

Patient groups were similar for demographic, biology and tumor characteristics (mean lesion size was 18mm in both groups). LTP at two-year follow up was not different between the two groups (RFA: 11.5%; MWA: 6%, p=0.27). TTP was similar (RFA 16 months (SD:6.5) and MWA 12 months (SD:8.2); p=0.28), confirmed by analysis with competition risk and inverse probability of censoring weighting analyses accounting for transplantation or death. Survival at two years was not different: RFA group 87%, MWA group 89% (p=0.78). Rate of complication was low with two grade 4 complications (SIR classification), both in MWA group.

CONCLUSION

This prospective randomized study with patients with HCC <=4cm treated either by RFA or MWA evidenced no difference in local tumor progression and survival at two-year follow-up.

CLINICAL RELEVANCE/APPLICATION

MWA has theoretical advantages over RFA: shorter ablation time, higher temperature of ablation, reduction of heat-sink effect and treatment of larger lesions. Our study demonstrates that MWA does not add clinical benefit over RFA for LTP and survival at two years.







VSPD11

Pediatric Series: Neuroradiology

Sunday, Nov. 26 10:45AM - 12:15PM Room: E451B



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

Participants

Manohar M. Shroff, MD, Toronto, ON (*Moderator*) Nothing to Disclose Erin S. Schwartz, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

VSPD11-01 MR Imaging of the Term Neonatal Brain

Sunday, Nov. 26 10:45AM - 11:05AM Room: E451B

Participants

Manohar M. Shroff, MD, Toronto, ON (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Review causes of neonatal encephalopathy and common clinical presentations. 2) Discuss 'how to' optimize neonatal MRI technique for the brain and suggest a standardized protocol. 3) Describe patterns of hypoxic-ischemic encephalopathy in the term neonate. 4) Briefly review possible differential diagnosis and medico-legal implications.

ABSTRACT

Magnetic resonance imaging (MRI) is an important tools in identifying the etiology of neonatal encephalopathy as well as in predicting long-term outcomes. MRI is now the main imaging method for defining the extent of neonatal brain injury. This presentation will review how to optimize MR techniques to determine the cause of encephalopathy in the newborn. The neonatal brain is largely unmyelinated and is undergoing maturation rapidly. It is important understand normal appearances of neonatal brain on MRI and to be familiar with the spectrum of imaging features in ischemic and non-ischemic neonatal encephalopathy. Hypoxic ischemic injury (HII) is one of the most common causes of neonatal encephalopathy and imaging appearances are influenced by the stage of maturation of the neonatal brain, severity as well as duration of ischemic insult and treatment given, such as hypothermia. Conceptually, hypoxic ischemic injury at birth has been differentiated into prolonged intermittent hypoxic ischemic injury due to ischemia occuring over a prolonged time and a severe acute or profound hypoxic ischemic injury (HII) often associated with a sentinel acute event. In the prolonged intermittent hypoxic injury, the cerebral white matter is more dominantly involved, whereas in the severe acute hypoxic injury, deep grey matter structures are involved. Imaging characteristics of HII in term neonates can be also subdivided based on the severity of injury (severe versus mild to moderate [partial] asphyxia). In practice one often sees a spectrum of injury, and Barkovich et al have published a useful MR scoring system to diagnose and rate the severity of injury secondary to HII. In addition to having a normal appearance, infants with suspected HII may have 4 predominant patterns of injury: watershed, basal ganglia, total, or focal-multifocal injury. Injury involving the deep grey matter structures, often portends a worse prognosis. In medico-legal situations, an attempt is often made to time HII, based on MRI patterns. It is important to understant that MRI findings alone cannot time the insult within hours or minutes around the time of birth. Timing is best done using and corelating MRI findings along with all other evidence that is available. The radiologist must also be familiar with other causes of neonatal encephalopathy, such as stroke, trauma, infections, congenital disorders and inborn errors of metabolism.

VSPD11-02 Resolution Dependence of Brain Metabolic MRI in Neonates

Sunday, Nov. 26 11:05AM - 11:15AM Room: E451B

Participants

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PURPOSE

Cerebral metabolic rate of oxygen (CMRO2) is an important biomarker of neural development and brain tissue viability in neonates, but non-invasive techniques to measure it in neonates have been lacking. In this work, we optimized a novel MRI method to evaluate CMRO2 in neonates by studying its dependence on spatial resolution.

METHOD AND MATERIALS

<u>Theory:</u> Previously we have demonstrated the proof-of-principle of a novel method based on the Fick Principle to quantify CMRO2, i.e., CMRO2=CBF·(Ya-Yv)·Ca, where CBF is cerebral blood flow measured by phase-contrast (PC) MRI, Ya is arterial oxygenation measured by pulse-oximetry, Yv is venous oxygenation measured by T2-Relaxation-Under-Spin-Tagging (TRUST), and Ca is the

well-established blood's oxygen carrying capacity. In this work, we aimed to optimize the TRUST and PC MRI techniques in neonates. <u>TRUST MRI:</u> In 9 healthy neonates, we compared the TRUST scans with 4 in-plane resolutions, 1.25, 1.5, 1.9 and 2.5 mm. We assessed the coefficient of variance (CoV) of the TRUST signal and a goodness-of-fit index, Δ R2, across the resolutions. <u>PC MRI:</u> In 3 healthy neonates, we compared the PC MRI scans with 3 in-plane resolutions, 0.3, 0.4 and 0.5 mm, and 3 numbers of averages, 3. 6 and 9 averages. We compared the CoV of CBF across the resolution and number of averages, respectively.

RESULTS

<u>TRUST MRI</u>: The 1.25mm resolution showed higher CoV (p<0.03) and Δ R2 (p<0.07) than the other resolutions. No significant differences in CoV and Δ R2 were found among the other 3 resolutions, although Δ R2 of 2.5mm is slightly lower than that of 1.5mm (p=0.10). Considering the trade-off between CoV and Δ R2, 1.9mm resolution is recommended for TRUST MRI in neonates. <u>PC MR</u>: The 3 resolutions showed no significant difference in CoV. More neonates are being scanned. The PC scan with 3 averages showed higher CoV than 6 averages (p=0.087) and 9 averages (p=0.004). Considering the trade-off between scan time and precision, 6 averages is recommended for PC MRI in neonates.

CONCLUSION

Our results suggested the used of 1.9mm resolution for TRUST MRI and 6 averages for PC MRI in neonates. These optimizations may lead to the accurate quantification of neonatal CMRO2 in 4 minutes without using any exogenous tracer or contrast agent.

CLINICAL RELEVANCE/APPLICATION

The optimized TRUST and PC MRI techniques can be used for the quantification of neonatal CMRO2, the functional biomarker in several neonatal brain injury and diseases.

VSPD11-03 Detection of 'Silent' Abnormalities in the Deep Gray Matter Nuclei of Neonates with Punctate White Matter Lesions by Magnetic Resonance Spectroscopy

Sunday, Nov. 26 11:15AM - 11:25AM Room: E451B

Participants

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PURPOSE

Punctate white matter lesions (PWML) are common in neonates and represent as hyperintensity on T1WI and hypointensity on T2WI in the periventricular white matter. In this study, the deep gray matter in PWML neonates without abnormality on conventional MRI and with possibility of injury would be considered as 'silent' lesions. The aim of this study is to explore whether there exist the 'silent' abnormalities in the deep gray matter nuclei in PWML neonates by magnetic resonance spectroscopy (MRS).

METHOD AND MATERIALS

42 neonates with PWML and 54 control neonates (no abnormality on conventional MRI) who underwent GE 3.0T MRS imaging were enrolled. The PWML neonates with gray matter lesions (i.e. hypoxic ischemic encephalopathy, bilirubin encephalopathy and hemorrhage) were excluded. Axial 2D MRS was performed with the point-resolved spectroscopy sequence (PRESS) (echo time/repetition time, 144ms/1000ms) through the basal ganglia. The peak areas ratios of Cho/Cr, NAA/Cho and NAA/Cr in bilateral lenticular nucleus and thalamus were calculated. Independent sample t test was performed to investigate the differences of metabolite ratios between PWML and control groups.

RESULTS

Demographics of neonates with PWML and control groups were shown in Table 1. There were no significantly differences in gestational age, postmenstrual age, postnatal age at scan, birth weight and gender between two groups(p>0.05). Figure 1, NAA/Cho ratio of both two regions in PWML group were significant lower than those in control group (p<0.05), and this difference of NAA/Cr ratio only in thalamus (p<0.05), while no differences of Cho/Cr ratio between PWML and control group were found in both two regions.

CONCLUSION

In the PWML neonates, the variations of metabolite ratios in MRS demonstrated a 'silent' abnormalities in the deep gray matter.

CLINICAL RELEVANCE/APPLICATION

The treatment strategies should target at both white and gray matter to prevent the neurologic deficits in the neonates with punctate white matter lesions.

VSPD11-04 To Evaluate the Role of F 18 FDG PET-CT in Evaluation of Temporal Lobe Epilepsy

Sunday, Nov. 26 11:25AM - 11:35AM Room: E451B

Participants

Sikandar M. Shaikh, DMRD, Hyderabad, India (Presenter) Nothing to Disclose

PURPOSE

18F-fluorodeoxyglucose (18F-FDG) has been used for localization of epileptogenic foci in cases of temporal lobe epilepsy. The aim of this study was to evaluate the glucose metabolic activity using 18F-FDG PET-CT imaging in patients with epilepsy.

METHOD AND MATERIALS

Thirty five pediatric epilepsy patients who underwent 18F-FDG PET-CT, magnetic resonance imaging (MRI) and electroencephalography (EEG) examinations were respectively included. Fifteen age-matched controls were included. 18F-FDG PET -CT was done after injecting FDG contrast .Images were analyzed by using visual assessment combined with statistical parametric mapping (SPM) analysis. Absolute asymmetry index (|AI|) were calculated in patients with regional abnormal glucose metabolism.

RESULTS

There was significant changes in the visual assessment combined with SPM analysis of 18F-FDG PET images detected more patients with abnormal glucose metabolism compared to the visual assessment only. The |AI| significantly positively correlated with seizure frequency (P < 0.001), but negatively correlated with the time since last seizure (P < 0.01) in patients with abnormal glucose metabolism. The only significant contributing variable to the |AI| was the time since last seizure, both in patients with hypometabolism (P = 0.001) and hyper-metabolism (P = 0.005). Higher values of |AI| were found in the drug-resistant compared to the seizure remission in patients with either hypo-metabolism (P < 0.01) or hyper-metabolism (P = 0.209). In the post 1-year follow-up PET studies, significant change of |AI| (%) was found in patients with clinical improvement compared to those with persistence or progression (P < 0.01).

CONCLUSION

18F-FDG PET imaging with visual assessment combined with SPM analysis could provide cerebral glucose metabolic profile in nonsurgical epilepsy patients. |AI| is more useful for evaluation of clinical severity and progress in these patients. Patients with a prolonged period of seizure free may have more subtle (or no) metabolic abnormalities on PET. The clinical value of PET might be enhanced by timing the scan closer to clinical seizure(s).

CLINICAL RELEVANCE/APPLICATION

FDG PET-CT has important role in evaluation of Epileptogenic focus in temporal lobe epilepsy .

VSPD11-05 Functional Magnetic Resonance Imaging Analysis of N-Back Working Memory Paradigm in Adolescents with Temporal Lobe Epilepsy

Sunday, Nov. 26 11:35AM - 11:45AM Room: E451B

Participants

Rupa Radhakrishnan, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose Thomas Maloney, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose Avani Modi, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose Shari Wade, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose Angela Combs, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose Jennifer Vannest, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Working memory is an important substrate of executive function dealing with storage, processing and manipulation of information. Adolescents with epilepsy are at risk for working memory deficits, which could lead to learning difficulties and poor academic outcomes. In this study, we compare functional magnetic resonance imaging (fMRI) correlates of working memory in adolescents with epilepsy versus healthy controls.

METHOD AND MATERIALS

29 adolescents (13 to 17y) with MRI non-lesional epilepsy and 20 matched healthy controls were prospectively recruited. Participants performed an N-back fMRI task (block design 2-back versus 0-back condition), and neuropsychological measures of working memory(Digit Span from the Wechsler Intelligence Scale). General linear model approach was used to create group activation maps contrasting 2-back vs0-back for epilepsy and control groups and both groups combined (initial threshold Z > 3.71, corrected for multiple comparisons to p<0.05). Functionally defined regions of interest (ROIs) were defined based on clusters of combined group activation. For each participant, mean Z-score values for fMRI activation were derived for each ROI. We examined correlations between mean Z-score in each ROI and Digit Span scaled scores.

RESULTS

For the N-back fMRI task, significant activation was observed in bilateral middle frontal and parietal regions, bilaterally, anterior cingulate cortex, and inferior parietal/occipital cortex and frontal operculum/insula bilaterally in both controls and epilepsy groups. There were no significant differences in group activation. Mean Digit Span scores in those with epilepsy (8.7) and controls (11.8) was significantly different (p=0.0009). Digit Span scaled scores correlated significantly with N-back fMRI activation in the left frontal pole (r =0.53, p=0.013), left frontal operculum/insula (r=0.53, p= 0.015) and left parieto-occipital region (r= 0.48, p= 0.034) in controls, which was not seen in adolescents with epilepsy.

CONCLUSION

There is a relationship between Digit Span performance scores and left frontal and left parieto-occipital activation on the N-back fMRI task in controls, but not in adolescents with epilepsy suggesting an atypical pattern of working memory processing in pediatric epilepsy.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates working memory deficits, and altered pattern of working memory processing in adolescents with epilepsy.

VSPD11-06 Mutual Information Improves Quantification of Cerebral Network Architecture in Children with Focal Epilepsy

Sunday, Nov. 26 11:45AM - 11:55AM Room: E451B

Wei Zhang, PhD, Houston, TX (*Presenter*) Nothing to Disclose Viktoria Muravina, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Robert Azencott, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Lynn Chapieski, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Zili David Chu, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Michael J. Paldino, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Metrics of brain network architecture derived from resting-state fMRI have been shown to provide physiologically meaningful markers of IQ in children with epilepsy. However, traditional measures of functional connectivity (FC), specifically correlation, assume gaussianity of the joint distribution between BOLD time courses; this assumption may not be valid. Mutual information (MI) is an alternative measure of FC which has shown promise in the study of complex networks due to its ability to characterize non-linear associations. We therefore aimed to compare network metrics derived from mutual information-defined FC to those derived from traditional correlation in terms of their capacity to predict patient-level IQ.

METHOD AND MATERIALS

Patients were retrospectively identified with: 1. Focal epilepsy; 2. Resting state fMRI; 3. Full scale IQ by a neuropsychologist. Brain network nodes were defined by anatomic parcellation. Parcellation was performed at three different node sizes, resulting in networks containing approximately 350, 750, or 1500 nodes. Whole-brain, weighted graphs were then constructed according to the pair-wise connectivity between nodes. In the traditional condition, edges (connections) between each pair of nodes were defined as the absolute value of the Pearson correlation coefficient between their BOLD time courses. In the mutual information condition, edges were defined as the mutual information between time courses. The following metrics were then calculated for each weighted graph: clustering coefficient, modularity, characteristic path length, and global efficiency. A machine learning algorithm was then used to predict the IQ of each individual based on their network metrics. Prediction accuracy was assessed as the percent variation explained for each condition.

RESULTS

Twenty-six patients met criteria (age: 4-18 yrs). Percent variance explained for each condition is presented in Table 1. Over all network sizes, network metrics derived from mutual information-defined FC outperformed the use of traditional correlation.

CONCLUSION

Mutual information-defined functional connectivity captured features of the brain network relevant to brain function better than traditional methods.

CLINICAL RELEVANCE/APPLICATION

Optimizing the capacity to predict cognitive phenotypes at the patient-level is a necessary step toward the clinical utility of network-based biomarkers.

VSPD11-07 Advanced Imaging of Pediatric Epilepsy

Sunday, Nov. 26 11:55AM - 12:15PM Room: E451B

Participants Erin S. Schwartz, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Improve knowledge of advanced imaging techniques, including magnetoencephalography and hybrid PET-MR imaging, for evaluating and guiding treatment of pediatric patients with medically refractory epilepsy.







RCA11

Case Review: Introduction to LI-RADS (Hands-on)

Sunday, Nov. 26 11:00AM - 12:30PM Room: S401AB



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

Participants

Ania Z. Kielar, MD, Ottawa, ON (*Presenter*) Research Grant, General Electric Company Cynthia S. Santillan, MD, San Diego, CA (*Presenter*) Consultant, Robarts Clinical Trials, Inc Kathryn J. Fowler, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose An Tang, MD, Montreal, QC (*Presenter*) Research Consultant, Imagia Cybernetics Inc; Speaker, Siemens AG Khaled M. Elsayes, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose Victoria Chernyak, MD,MS, Bronx, NY (*Presenter*) Nothing to Disclose Yuko Kono, MD, PhD, San Diego, CA (*Presenter*) Equipment support, Toshiba Medical Systems Corporation; Equipment support, General Electric Company; Equipment support, Lantheus Medical Imaging, Inc Thomas A. Hope, MD, San Francisco, CA (*Presenter*) Nothing to Disclose Robert M. Hecht, MD, New York, NY (*Presenter*) Nothing to Disclose Robert M. Marks, MD, San Diego, CA (*Presenter*) Nothing to Disclose Richard Kinh Gian Do, MD, PhD, New York, NY (*Presenter*) Consultant, Guerbet SA Donald G. Mitchell, MD, Philadelphia, PA (*Presenter*) Consultant, CMC Contrast AB

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LEARNING OBJECTIVES

1) Implement CT/MRI LI-RADS version 2017 when assessing liver observations in patients at risk for HCC 2) Recognize CT/MRI ancillary features and integrate these features into the final LI-RADS categorization 3) Integrate newly developed 2017 CT/MRI LI-RADS treatment response categories for HCC after locoregional therapies

ABSTRACT

In this 1.5 hour Hands-On Workshop, the participants will be seated at stand-alone computers and have the opportunity to review up to 25 MRI and CT cases of livers in patients at risk for HCC and characterize the observations based on the 2017 updated version of CT/MRI LI-RADS. The workshop will be led by world-renown experts in the field who are members of the LI-RADS steering committee. A short didactic review of LI-RADS 2017 updates will be offered at the start of the course. Following this introduction, workshop participants will have time to look at each case on their own, with support faculty available throughout the room to answer individual questions. Subsequently, each case will be reviewed by a faculty member in a didactic fashion, highlighting pearls for accurate use of LI-RADS in each case, with opportunity for questions. Focus will be on the overall integration of LI-RADS version 2017 into daily practice. This workshop will initially focus on the core imaging features post-contrast enhancement and work through the algorithm of how to assign a LI-RADS score. This workshop will also encompass ancillary imaging features and how to apply them to ensure standardized LI-RADS reporting of various types of liver observations. The workshop cases will include daily, non-academic practice examples, and include various levels of difficulty. Beginner cases as well as more challenging cases will be included in the workshop to help radiologists from all backgrounds integrate LI-RADS into their daily work. References: 1. LI-RADS major features: CT, MRI with extracellular agents, and MRI with hepatobiliary agents. Santillan C, Fowler K, Kono Y, Chernyak V. Abdom Radiol (NY). 2017 Aug 21. [Epub ahead of print] 2. LI-RADS: ancillary features on CT and MRI. Chernyak V, Tang A, Flusberg M, Papadatos D, Bijan B, Kono Y, Santillan C. Abdom Radiol (NY). 2017 Jun 24. [Epub ahead of print] 3. Management implications and outcomes of LI-RADS-2, -3, -4, and -M category observations. Mitchell DG, Bashir MR, Sirlin CB. Abdom Radiol (NY). 2017 Aug 4. [Epub ahead of print] 4. Locoregional therapies for hepatocellular carcinoma and the new LI-RADS treatment response algorithm. Kielar A, Fowler KJ, Lewis S, Yaghmai V, Miller FH, Yarmohammadi H, Kim C, Chernyak V, Yokoo T, Meyer J, Newton I, Do RK. Abdom Radiol (NY). 2017 Aug 5. [Epub ahead of print]

Active Handout: Ania Zofia Kielar

http://abstract.rsna.org/uploads/2017/17002587/Active RCA11.pdf

Honored Educators

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https://www.rsna.org/Honored-Educator-Award/ Ania Z. Kielar, MD - 2017 Honored EducatorKhaled M. Elsayes, MD - 2014 Honored EducatorKhaled M. Elsayes, MD - 2017 Honored Educator







RCB11

Hands-On Basic DICOM with Horos/Osirix (Hands-on)

Sunday, Nov. 26 11:00AM - 12:30PM Room: S401CD

IN

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

Participants

Ross W. Filice, MD, Chevy Chase, MD (*Moderator*) Nothing to Disclose Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose Simon Rascovsky, MD, MSc, Bogota, Colombia (*Presenter*) Director, Nucleus Health, LLC Ross W. Filice, MD, Chevy Chase, MD (*Presenter*) Nothing to Disclose Bryce A. Merritt, MD, San Francsico, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe basic DICOM object metadata structure. 2) Demonstrate familiarity with Osirix/Horos DICOM viewer functions including image display, and measurements. 3) Use Osirix/Horos to send/receive DICOM objects. 4) Name several common dcm4che toolkit tools, and describe their purpose.







RCC11

Reject Rate Analysis in the Digital Era: Leveraging Informatics to Enhance Quality Control in Radiography

Sunday, Nov. 26 11:00AM - 12:30PM Room: S501ABC

IN

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

Participants

Kevin Little, PhD, Chicago, IL (Moderator) Nothing to Disclose

Sub-Events

RCC11A Setting Up a Unified Database for Multi-vendor Reject Analysis

Participants

Kevin Little, PhD, Chicago, IL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Define rejected images and reject rate. 2) Identify sources of rejected image data. 3) Develop a plan for data aggregation. 4) Recognize pitfalls of data collection and analysis.

RCC11B Initial Clinical Experience: Reasons for Rejects and Remedial Actions

Participants Ingrid Reiser, PhD, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ireiser@uchicago.edu

LEARNING OBJECTIVES

1) Understand the importance of monitoring reject rates in digital radiography. 2) Develop effective remedial actions. 3) Recognize pitfalls of remedial actions. 4) Understand the trade-off between reject rate and quality standards.

RCC11C Strategies for Repeat Analysis Program: Implementation and Expectations

Participants

Alisa Walz-Flannigan, PhD, Rochester, MN (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the scope of information needed for repeat analysis aimed at quality improvement. 2) Learn how to harness a repeat analysis program for quality improvement: objectives, workflow, and practice engagement. 3) Appreciate the clinical value of a comprehensive repeat analysis program through practical examples of quality improvement. 4) Recognize the role of informatics: the need for standard data and analytics tools.







VSI011

Interventional Oncology Series: Lung, Kidney and Bone

Sunday, Nov. 26 1:30PM - 6:00PM Room: S405AB

CH GU IR MK

AMA PRA Category 1 Credits ™: 4.00 ARRT Category A+ Credits: 4.75

FDA Discussions may include off-label uses.

Participants

Christos S. Georgiades, MD, PhD, Baltimore, MD (*Moderator*) Consultant, Boston Scientific Corporation; Consultant, Galil Medical Ltd Sean M. Tutton, MD, Milwaukee, WI (*Moderator*) Medical Director, Benvenue Medical, Inc; Consultant, Benvenue Medical, Inc; Researcher, Siemens AG; Consultant, BTG International Ltd

LEARNING OBJECTIVES

1) To show attendees the possible complications related to percutaneous ablation for Lung, Kidney and Bone tumors. 2) To present pre-ablation maneuvers that mitigate those risks. 3) To describe treatments/interventions that minimize the impact of those complications, once they occur.

Sub-Events

VSI011-01 Keynote and Series Opening: Interventional Oncology - Where We Stand and Where We Go

Sunday, Nov. 26 1:30PM - 2:00PM Room: S405AB

Participants

Stephen B. Solomon, MD, New York, NY (Presenter) Research Grant, General Electric Company

LEARNING OBJECTIVES

View Learning Objectives under main course title

VSI011-02 Evidence-Based Lung Cancer Ablation

Sunday, Nov. 26 2:00PM - 2:20PM Room: S405AB

Participants

Terrance T. Healey, MD, Providence, RI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

VSI011-03 Complications of Lung Cancer Ablation: Prevention & Treatment

Sunday, Nov. 26 2:20PM - 2:35PM Room: S405AB

Participants Samdeep Mouli, MD, Chicago, IL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

VSIO11-04 Histological Subtype as a Predictor of Localized Recurrence after Thermal Ablation of Lung Adenocarcinoma

Sunday, Nov. 26 2:35PM - 2:45PM Room: S405AB

Awards

Student Travel Stipend Award

Participants

Seth Stein, MD, New York, NY (*Presenter*) Nothing to Disclose Song Gao, New York, NY (*Abstract Co-Author*) Nothing to Disclose Waleed M. Shady, MBBCh, New York, NY (*Abstract Co-Author*) Nothing to Disclose Elena N. Petre, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Jeremy C. Durack, MD, New York, NY (*Abstract Co-Author*) Scientific Advisory Board, Adient Medical Inc; Investor, Adient Medical Inc; Carole A. Ridge, MD, Dublin 7, Ireland (*Abstract Co-Author*) Nothing to Disclose Prasad Adusumilli, New York City, NY (*Abstract Co-Author*) Nothing to Disclose Stephen B. Solomon, MD, New York, NY (*Abstract Co-Author*) Research Grant, General Electric Company Etay Ziv, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate whether histologic subtyping from biopsies can predict local recurrence after thermal ablation for lung adenocarcinoma.

METHOD AND MATERIALS

Patients treated with percutaneous thermal ablation for lung adenocarcinoma that had pre-ablation needle biopsy with analysis of histological components were identified. Age, gender, smoking status, treatment indication (primary stage 1 tumor versus salvage), histologic subtype, ground glass radiographic appearance, tumor size, ablation modality, and ablation margin were evaluated in relation to time to local recurrence (TTLR). Cumulative incidence of recurrence (CIR) was calculated using competing risks analysis and compared across groups using Fine and Grey method with clustering. Multivariate analysis was conducted with stepwise regression.

RESULTS

There were 45 patients with 49 lesions diagnosed as adenocarcinoma on pre-ablation biopsy and with histologic subtype analysis. Of these, 22% (11) had micropapillary components, 14% (7) had solid components, and 37% (18) had high grade components (defined as presence of micropapillary, solid, mucinous, and/or cribiform components). In the univariate analysis, solid (subdistribution hazard ratio [SHR]=4.63, p=0.005, 95% confidence interval [CI]=1.59-13.5), micropapillary (SHR=4.42, p=0.0051, CI=1.56-12.5), and high grade (SHR=14.5, p=0.0051, CI=3.21-65.5) were significantly correlated with shorter TTLR. On multivariate analysis, high grade (SHR 14.5., 95% CI: 3.22-65.3, p=0.0005) was the only independent predictor TTLR. The 1, 2, and 3-year CIR in patients with high grade tumors was 29%, 45%, and 62% compared to 0%, 8% and 8% in patients with non-high grade tumors.

CONCLUSION

High grade histological components identified in pre-ablation biopsy are associated with shorter TTLR thermal ablation of lung adenocarcinoma.

CLINICAL RELEVANCE/APPLICATION

This study supports the utility of biopsy for histologic subtype as a prognostic indicator of faster local recurrence prior to lung ablation.

VSI011-05 Evidence Base for Kidney Cancer Ablation

Sunday, Nov. 26 2:45PM - 3:05PM Room: S405AB

Participants

David J. Breen, MD, Southampton, United Kingdom (*Presenter*) Proctor, BTG International Ltd; Proctor, Galil Medical Ltd; Proctor, Johnson&Johnson; Proctor, NeuWave Medical, Inc

For information about this presentation, contact:

david.breen@uhs.nhs.uk

LEARNING OBJECTIVES

1. To appreciate the unique tumour biology and behavior of T1 a and b renal cancer and how this imfluences the outcome data.2. To understand the relative merits and limitations of traditional, standard of care renal surgery and how partial, laparoscopic and robotic partial nephrectomy impinge influence the debate.3. To gain insight into the relative merits and limitations of renal radio-frequency and cryoablation.4. To appreciate the current standing of the evidence for image-guided ablation of both T1a and T1b renal tumours.5. To understand how traditional cancer outcome metrics can be problematic in T1 renal cancer and how costs and complications also play a central role in the evidence for smaller renal cancer ablation.

LEARNING OBJECTIVES

1) To appreciate the natural history and epidemiology of T1 renal cell carcinoma(RCC) and how this impinges on the currently available oncological outcome data for image-guided ablation of RCC. 2) Clarify frailties of the currently available outcome data on RCC ablation. 3) To outline the currently available evidence base for renal tumour ablation, including the relative merits of radiofrequency versus cryoablation. 4) To understand how the evidence base might be forthcoming and underpinned by analysis of relative complications and cost-effectiveness incurred by surgical resection.

VSI011-06 Complications of Kidney Cancer Ablation: Prevention & Treatment

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Sunday, Nov. 26 3:05PM - 3:20PM Room: S405AB
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Participants

Kelvin K. Hong, MD, Baltimore, MD (*Presenter*) Scientific Advisory Board, Boston Scientific Corporation; Scientific Advisory Board, BTG International Ltd; Research support, Merit Medical Systems, Inc;

LEARNING OBJECTIVES

The participant will be exposed to common complications related to percutaneous renal ablation, and the participant will be introduced to strategies to recognize and mitigate/correct them.

LEARNING OBJECTIVES

View Learning Objectives under main course title

VSIO11-07 3D Quantitative Imaging Biomarkers as Predictors for Systemic Disease Progression in Patients with Renal Cell Carcinoma Undergoing Ablation

Bruno R. Tegel, Berlin, Germany (*Presenter*) Nothing to Disclose Todd Schlachter, MD, Farmington, CT (*Abstract Co-Author*) Nothing to Disclose Steffen Huber, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Jeffrey S. Pollak, MD, Woodbridge, CT (*Abstract Co-Author*) Nothing to Disclose Ming De Lin, PhD, Cambridge, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV Jean-Francois H. Geschwind, MD, Westport, CT (*Abstract Co-Author*) Consultant, Koninklijke Philips NV; Consultant, Terumo Corporation; Consultant, Bayer AG; Consultant, Boston Scientific Corporation; Consultant, BTG International Ltd; Consultant, Bristol-Myers Squibb Company; Consultant, Johnson & Johnson; Consultant, Guerbet SA; Consultant, Merck & Co, Inc; Research Grant, Boston Scientific Corporation; Research Grant, BTG International Ltd; Research Grant, Guerbet SA; Research Grant, Koninklijke Philips NV; Research Grant, PreScience Labs, LLC; Founder and CEO, PreScience Labs, LLC Julius Chapiro, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV

PURPOSE

To investigate the role of 3-dimensional quantitative imaging biomarkers such as tumor volume and enhancing tumor volume as predictors of extra-renal metastatic progression and progression free survival in patients with renal cell carcinoma (RCC) undergoing image-guided tumor ablation and to compare the prognostic value with TNM stage, R.E.N.A.L. score and tumor diameter.

METHOD AND MATERIALS

A HIPAA-compliant retrospective analysis with approval of the Institutional Review Board and waiver of informed consent was performed. A total of 37 patients with RCC that were treated with ablation (radiofrequency- or cryoablation) at our institution between 2007 and 2015. TNM stage, R.E.N.A.L. score, tumor diameter, tumor volume and enhancing tumor volume were measured on dynamic, contrast-enhanced CT or MRI imaging at baseline and correlated with occurrence of extrarenal metastases and progression free survival (PFS) after ablation.

RESULTS

Time to extra-renal metastases: While no significant difference was observed with stratification of the cohort according to TNM stage, R.E.N.A.L. score and tumor diameter, the stratification according to tumor volume and enhancing tumor volume of >= 5 cm3 versus < 5 cm3 resulted in a statistically significant stratification (p = 0.022 and p = 0.016, respectively) with an Odds ratio of 6.69 (95% CI, 0.33-134.4) and 8.48 (95% CI, 0.42-170.1). PFS: None of the conventional measures achieved significant separation of the survival curves. Only when stratified by enhancing tumor volume, did the survival differ significantly (p = 0.039) in both groups with an Odds Ratio of 2.25 (95% CI, 0.54-9.35) for patients with an enhancing tumor volume >= 5 cm3 versus < 5 cm3. Median PFS was 49.3 months (95% CI, 28.9-69.7) in the group with high enhancing tumor volume versus 68.2 months (95% CI, 53.8-82.7) in patient with lower enhancing tumor volume.

CONCLUSION

Quantification of enhancing tumor volume on baseline imaging demonstrated superiority over all other assessment techniques and can be used as a prognostic imaging biomarker for the development of extra-renal metastases and as an early surrogate for expected PFS in patients with RCC.

CLINICAL RELEVANCE/APPLICATION

The enhancing tumor volume is a readily available imaging biomarker with a strong predictive value for therapeutic outcomes and may lead to a more precise, personalized patient surveillance post ablation.

VSI011-08 Bone Ablation: Technique & Outcomes

Sunday, Nov. 26 3:45PM - 4:05PM Room: S405AB

Participants

Anil N. Kurup, MD, Rochester, MN (Presenter) Research Grant, Galil Medical Ltd Royalties, UpToDate, Inc

LEARNING OBJECTIVES

View Learning Objectives under main course title

VSI011-09 Cementoplasty for Malignant Bone Lesions

Sunday, Nov. 26 4:05PM - 4:20PM Room: S405AB

Participants

Alexios Kelekis, MD, PhD, Athens, Greece (Presenter) Speaker, Toshiba Medical Systems Corporation

For information about this presentation, contact:

akelekis@med.uoa.gr

LEARNING OBJECTIVES

1) To understand the complex anatomy related to treating by cementoplasty. 2) To distinguish the different types of malignant lesions and decide appropriate treatment. 3) To show technical approaches for the spine and peripheral skeleton. 4) To manage treatment and have appropriate strategy according to the malignant lesion at hand. 5) To learn how to manage complications.

ABSTRACT

Nearly 60% of oncologic patients will develop osseous metastasis with bone pain. A significant number of patients have intractable pain, unresponsive to medical treatment that will need complementary therapy. External beam radiation is part of the initial approach, but not always effective in providing complete or durable pain relief. It is also associated with neural damage and osteonecrosis of the irradiated area. In order to provide a more long term and sustainable treatment, percutaneous approaches have been developing, both for primary and metastatic disease. The have advantages and disadvantages, compared to open surgery, including but not limited to short hospitalization, immediate return to medical treatment and quick healing process. Disadvantages mainly rely on restrictions about the size and type of lesions to be treated, as well as the debulking capabilities of percutaneous approaches. A multitude of metastatic lesions can be treated such as renal, lung, melanoma, breast and prostate,

myeloma and lymphoma. Percutaneous cementoplasy is a term referring to the injection of substrates inside bone; usually polymers which pass from a liquid, injectable state, to a solid state. During the liquid phase the injection is being performed. The injectates have the advantage to stabilize the lytic lesion and at the same time provide a loco regional effect. Additionally they can be combined with other materials (metal or plastic) for structural support, as well as other treatments such as ablation or embolization, to enhance the loco-regional tumor effect. Nowadays, cementoplasty can be performed in most osseous sites, including spine, pelvis and long bones, using a variation of techniques and approaches. Imaging guidance is also very important. Correct alignment and image projection defines the approach and the delivery. Assessing imaging, recognizing vital structures, as well as technical and imaging skills in order to access the lesion, is part of the knowledge needed. Finally, the treatment goal should be related to the patient lesion type and survival probability. One should define whether treatment is associated with purely palliative or loco-regional tumor control. The choice will orientate the treatment strategy.

VSI011-10 Imaging Optimization by Twin-Beam Dual Energy Computed Tomography to Improve Visualization of Therapeutic Ice Ball Margins During Cryoablation of Musculoskeletal Malignancies

Sunday, Nov. 26 4:20PM - 4:30PM Room: S405AB

Participants

Steven Yevich, MD, MPH, Houston, TX (Presenter) Nothing to Disclose

Gouthami Chintalapani, Hoffman Estates, IL (Abstract Co-Author) Nothing to Disclose

Rahul A. Sheth, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

Steven Y. Huang, MD, Houston, TX (Abstract Co-Author) Scientific Advisory Board, Adient Medical Inc

Sharjeel Sabir, MD, Houston, TX (*Abstract Co-Author*) Travel support, Merit Medical Systems, Inc; Travel support, Boston Scientific Corporation; Travel support, NeuWave Medical, Inc

Alda L. Tam, MD, Houston, TX (Abstract Co-Author) Medical Monitor, Galil Medical Ltd; Research Grant, AngioDynamics, Inc;

PURPOSE

To evaluate the applicability of twin-beam dual energy computed tomography (DECT) for improved assessment of therapeutic ice ball ablation margins during cryoablation of musculoskeletal malignancies.

METHOD AND MATERIALS

Twin beam DECT was acquired for 5 initial patients in a new ongoing initiative during cryoablation of musculoskeletal malignancies as a radiation dose neutral alternative to standard CT acquisition. All ablated masses were located in close proximity to bone (within 1 cm) or originated within bone, with or without extra-osseous soft tissue extension. The original 120kV X-ray beam was pre-filtered into two X-ray spectra using gold (Au) and tin (Sn) filters. Specific post processing was applied to generate a spectrum of monochromatic images ranging from 40KeV to 190KeV. These images were manipulated to identify the appropriate kV that best characterized the margins of the therapeutic ice ball in order to assist the interventional radiologist in clinical assessment of lesional coverage.

RESULTS

Ability to quickly manipulate the post-processed monochromatic images along the 40-190 KeV spectrum allowed improved visualization of ice ball margins for musculoskeletal malignancies. The interface between ice ball and soft tissue was best depicted on the lower end of the energy spectrum of approximately 60-70KeV. In the immediate proximity to metallic needle artifacts or dense bony structure, a high energy spectrum of approximately 90-120KeV improved the ice ball margin visualization.

CONCLUSION

Early evaluation in this ongoing trial suggests a clinic advantage to dual energy CT with monochromatic spectral analysis to improve identification of the cryoablation ice ball margins and overcome substantial visibility challenges caused by relative density variability in musculoskeletal tissues and metallic needle artifacts.

CLINICAL RELEVANCE/APPLICATION

Substantial challenges are present when performing cryoablation musculoskeletal malignancy as ice ball margins prove difficult to visualize due to the high variability in relative density of the muscle, fat, and bone. In addition, metallic needle artifact from cryoablation probes also leads to ice ball margin obscuration. Twin beam dual energy CT may provide a real clinical advantage as a dose neutral post-processing application to assist the interventionalist in therapeutic decision making during cryoablation.

VSIO11-11 Advantages of RFA vs MW vs CRYO: Physics Based Approach

Sunday, Nov. 26 4:30PM - 4:45PM Room: S405AB

Participants

Matthew R. Callstrom, MD, PhD, Rochester, MN (*Presenter*) Research Grant, EDDA Technology, Inc; Research Grant, Galil Medical Ltd; Consultant, Medtronic plc; Consultant, Endocare, Inc; Consultant, Johnson and Johnson; Consultant, Thermedical, Inc;

For information about this presentation, contact:

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LEARNING OBJECTIVES

After attending this lecture, the attendee should be able to describe the characteristics of different ablation systems. After attending this lecture, the attendee should be able to describe how different ablation systems can be applied to the treatment of tumors. After attending this lecture, the attendee should be able to describe unique advantages of different ablation systems for specific interventional oncology applications.

LEARNING OBJECTIVES

View Learning Objectives under main course title

VSI011-12 Tumor Boards: Techniques and Challenging Cases in Lung, Kidney and Bone

Participants

Debra A. Gervais, MD, Boston, MA (Presenter) Nothing to Disclose

Terrance T. Healey, MD, Providence, RI (Presenter) Nothing to Disclose

Samdeep Mouli, MD, Chicago, IL (Presenter) Nothing to Disclose

Muneeb Ahmed, MD, Wellesley, MA (*Presenter*) Research Grant, General Electric Company; Stockholder, Agile Devices, Inc; Scientific Advisory Board, Agile Devices, Inc

David J. Breen, MD, Southampton, United Kingdom (*Presenter*) Proctor, BTG International Ltd; Proctor, Galil Medical Ltd; Proctor, Johnson&Johnson; Proctor, NeuWave Medical, Inc

Kelvin K. Hong, MD, Baltimore, MD (*Presenter*) Scientific Advisory Board, Boston Scientific Corporation; Scientific Advisory Board, BTG International Ltd; Research support, Merit Medical Systems, Inc;

Christos S. Georgiades, MD, PhD, Baltimore, MD (*Presenter*) Consultant, Boston Scientific Corporation; Consultant, Galil Medical Ltd Anil N. Kurup, MD, Rochester, MN (*Presenter*) Research Grant, Galil Medical Ltd Royalties, UpToDate, Inc

Alexios Kelekis, MD, PhD, Athens, Greece (Presenter) Speaker, Toshiba Medical Systems Corporation

Matthew R. Callstrom, MD, PhD, Rochester, MN (*Presenter*) Research Grant, EDDA Technology, Inc; Research Grant, Galil Medical Ltd; Consultant, Medtronic plc; Consultant, Endocare, Inc; Consultant, Johnson and Johnson; Consultant, Thermedical, Inc; Sean M. Tutton, MD, Milwaukee, WI (*Presenter*) Medical Director, Benvenue Medical, Inc; Consultant, Benvenue Medical, Inc; Researcher, Siemens AG; Consultant, BTG International Ltd

LEARNING OBJECTIVES

1. To recognize some of the rare complications associated with percutaneous ablation 2. To learn mitigate maneuvers that minimize the risks of such complications 3. To learn how to address these complications should they occur

LEARNING OBJECTIVES

View Learning Objectives under main course title

Honored Educators

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RC101

Interstitial Lung Disease: Update 2017

Sunday, Nov. 26 2:00PM - 3:30PM Room: S406A

СН СТ

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

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Sub-Events

RC101A Pulmonary Fibrosis

Participants

David A. Lynch, MBBCh, Denver, CO (*Presenter*) Research support, Siemens AG; Research Consultant, PAREXEL International Corporation; Research Consultant, Boehringer Ingelheim GmbH; Research Consultant, F. Hoffmann-La Roche Ltd; Research Consultant, Veracyte, Inc;

LEARNING OBJECTIVES

Understand how to distinguish between common fibrosing interstitial pneumonias, usual interstitial pneumonia, nonspecific interstitial pneumonia, and chronic hypersensitivity pneumonitis. Know the guidelines for diagnosis of idiopathic pulmonary fibrosis, as recently updated by the Fleischner Society.

RC101B Hypersensitivity Pneumonitis

Participants

Santiago E. Rossi, MD, Capital Federal, Argentina (*Presenter*) Advisory Board, Koninklijke Philips NV; Advisory Board, Boehringer Ingelheim GmbH; Speaker, Boehringer Ingelheim GmbH; Royalties, Springer Science+Business Media Deutschland GmbH

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Review the most common imaging findings of hypersensitivity pneumonitis (HP) (case based). 2) Describe clinical manifestations of HP. 3) Identify the newly proposed classification of HP.

Active Handout:Santiago E. Rossi

http://abstract.rsna.org/uploads/2017/17000307/Active RC101B.pdf

Honored Educators

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RC101C Smoking-Related Interstitial Lung Diseases

Participants

Carolina A. Souza, MD, Ottawa, ON (*Presenter*) Consultant, Pfizer Inc; Consultant, Boehringer Ingelheim GmbH; Consultant, F. Hoffmann-La Roche Ltd; Speaker, Pfizer Inc; Speaker, Boehringer Ingelheim GmbH; Speaker, F. Hoffmann-La Roche Ltd

For information about this presentation, contact:

csouza@toh.on.ca

LEARNING OBJECTIVES

1) Describe the spectrum of smoking-related interstitial lung diseases and their clinical manifestations. 2) Recognize the highresolution CT appearances of smoking-related lung diseases. 3) Identify the most common imaging differential diagnoses of smoking-related interstitial lung diseases.

Active Handout:Carolina A. Souza

http://abstract.rsna.org/uploads/2017/17000308/Active RC101C.pdf

RC101D Sarcoidosis

Participants Lacey Washington, MD, Durham, NC (*Presenter*) Nothing to Disclose

lacey.washington@duke.edu

LEARNING OBJECTIVES

1) Review the classic clinical and imaging manifestations and common complications of thoracic sarcoidosis. 2) Review less well known clinical features and imaging findings.







RC102

Challenges in International Radiology Training

Sunday, Nov. 26 2:00PM - 3:30PM Room: N229

ED

AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 0

Participants

Aarti Sekhar, MD, Atlanta, GA (Moderator) Nothing to Disclose

For information about this presentation, contact:

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Sub-Events

RC102A ACGME I Experience

Participants Kay H. Vydareny, MD, Tucson, AZ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Explain the mission and review process of the ACGME-International (ACGME-I). 2) List the main similarities and differences between the program requirements in Diagnostic Radiology for the ACGME and the ACGME-I. 3) Explain the ACGME requirements for an international rotation in Diagnostic Radiology.

RC102B Mexico Experience

Participants

Guillermo Elizondo-Riojas, MD, PhD, Monterrey, Mexico (Presenter) Research Consultant, Avenu Medical, Inc

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elizondoguillermo@hotmail.com

LEARNING OBJECTIVES

1) To describe the current situation in the radiology programs of Mexico. 2) To recognize the current challenges for the teaching of radiology in different sites around Mexico. 3) To evaluate the future perspectives for the learning/teaching environment.

RC102C Guyana Experience

Participants Gillian M. Battino, MD, Wausau, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To describe my personal introduction to radiology outreach and how it fits into my career and life. 2) To briefly describe how and why I came to work with RAD-AID, the mission and vision of RAD-AID and how these relate to the Guyana program. 3) To talk about curriculum, formative and summative assessment, staffing, equipment and other challenges. 4) To share our progress and hopefully introduce the first class of residents (who will hopefully be in the USA) beginning their training.







RC103

Read with the Experts (Cardiac Radiology) (An Interactive Session)

Sunday, Nov. 26 2:00PM - 3:30PM Room: S105AB

CA

AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 0

Participants

Jill E. Jacobs, MD, New York, NY (*Moderator*) Nothing to Disclose Sanjeev Bhalla, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose Smita Patel, MBBS,FRCR, Ann Arbor, MI (*Presenter*) Nothing to Disclose Eric E. Williamson, MD, Rochester, MN (*Presenter*) Nothing to Disclose Amar B. Shah, MD, Queens, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ashah27@northwell.edu

ewilliamson@mayo.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.

SAM

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Honored Educators

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RC104

Emerging Clinical Applications in Musculoskeletal Imaging

Sunday, Nov. 26 2:00PM - 3:30PM Room: S406B



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

FDA Discussions may include off-label uses.

Participants

Martin Torriani, MD, Boston, MA (Director) Nothing to Disclose

For information about this presentation, contact:

mtorriani@mgh.harvard.edu

LEARNING OBJECTIVES

1) To familiarize attendees with emerging imaging techniques in musculoskeletal imaging and their practical application in the clinical setting. 2) Topics include: MR spectroscopy of the musculoskeletal system, MR neurography, novel MR imaging techniques and pulse sequences, dual-energy computed tomography, and imaging of sarcopenia.

Sub-Events

RC104A Spectroscopy in Clinical Practice

Participants

Martin Torriani, MD, Boston, MA (Presenter) Nothing to Disclose

For information about this presentation, contact:

mtorriani@mgh.harvard.edu

LEARNING OBJECTIVES

1) MR spectroscopy allows for metabolic characterization of musculoskeletal tissues and has shown promise in applications such as characterization of tumors and body composition. 2) This lecture will focus on technical aspects to successfully obtain and interpret MR spectroscopy data in a clinical setting and outline clinical applications of this technique.

RC104B Neurography in Clinical Practice

Participants Laura M. Fayad, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

lfayad1@jhmi.edu

LEARNING OBJECTIVES

1) Understand the importance of peripheral nerve imaging to routine clinical practice. 2) Identify common sports-related peripheral neuropathies. 3) Learn useful MRI features of peripheral nerve injury. 4) Improve knowledge regarding MRI techniques used for assessing the peripheral nervous system.

RC104C MRI Sequences You May Want to Try

Participants

Michael P. Recht, MD, New York, NY (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the basic principles of fast imaging techniques such as parallel imaging, compressed sensing and machine learning reconstruction and show how they can be applied to musculoskeletal imaging.

RC104D Clinical Applications of Dual Energy CT

Participants

Carl S. Winalski, MD, Cleveland, OH (*Presenter*) Institutional service agreement, Medical Metrics, Inc; Institutional service agreement, BioClinica, Inc; Institutional service agreement, PAREXEL International Corporation; Institutional service agreement, CartiHeal Ltd; Shareholder, Pfizer Inc; Spouse, Shareholder, General Electric Company

For information about this presentation, contact:

winalsc@ccf.org

1) Review the applications of dual-energy computed tomography currently used in clinical practice through case examples.

RC104E Sarcopenia in Clinical Practice

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 transition of sarcopenia from the research environment to clinical practice.







RC105



Sunday, Nov. 26 2:00PM - 3:30PM Room: N227B



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

FDA Discussions may include off-label uses.

Participants

Srinivasan Mukundan, MD, PhD, Durham, NC (*Moderator*) Institutional research support, Siemens AG; Institutional research support, Toshiba Medical Systems Corporation; Consultant, Toshiba Medical Systems Corporation;

LEARNING OBJECTIVES

1) Describe the 3 processes involved in the creation of brain MR elastograms. 2) Classify focal brain lesions based on their viscoelastic properties and brain adhesion measured by slip interface imaging. 3) Explain the future role of brain MR elastography in differentiating diffuse neurologic diseases including the common causes of dementia. 4) Understand the limitations of current diagnostic algorithms for intracranial vascular disease. 5) Understand the techniques, applications and value of intracranial vessel wall imaging. 6) Understand future directions of vessel wall imaging. 7) Understand recent developments in simultaneous MR/PET imaging of the brain. 8) Evaluate outstanding technical challenges, including MR attenuation correction, image-derived arterial input functions, and workflow. 9) Review the role of simultaneous MR/PET for common neurologic diseases, such as dementia, cerebrovascular disease, and tumors.

SAM

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Sub-Events

RC105A Clinical 7T Brain MRI

Participants

Jeroen Hendrikse, MD, Utrecht, Netherlands (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe where 7 Tesla MRI can have added value in clinical neuroradiology. 2) Show the clinical added value of 7 Tesla MRI for the detection of small infarcts on high resolution 3D FLAIR sequences, the detection of small pituitary lesions with pre and post contrast 3DT1 MRI sequences and the detection of intracranial atheroslerosis with black blood vessel wall MRI sequences before and after contrast. 3) Explain the future directions of clinical 7 Tesla MRI and the importance of contrast-to-noise ratio (CNR) above signal-to-noise ratio (SNR).

RC105B MR/PET in the Brain

Participants

Greg Zaharchuk, MD, PhD, Stanford, CA (*Presenter*) Research Grant, General Electric Company; Consultant, General Electric Company;

LEARNING OBJECTIVES

1) Understand recent developments in simultaneous MR/PET imaging of the brain. 2) Evaluate outstanding technical challenges, including MR attenuation correction, image-derived arterial input functions, and workflow. 3) Review the role of simultaneous MR/PET for common neurologic diseases, such as dementia, cerebrovascular disease, and tumors.

RC105C MR Elastography: Palpating the Brain

Participants

John Huston III, MD, Rochester, MN (Presenter) Stockholder, Resoundant, Inc; Royalties, Resoundant, Inc

For information about this presentation, contact:

jhuston@mayo.edu

LEARNING OBJECTIVES

1) Describe the three processes involved in the creation of brain MR elastograms. 2) Classify focal brain lesions based on their viscoelastic properties and brain adhesion measured by slip interface imaging. 3) Explain the future role of brain MR elastography in differentiating diffuse neurologic diseases including the common causes of dementia.







RC106

Essentials of Orbital Imaging

Sunday, Nov. 26 2:00PM - 3:30PM Room: E351

HN NR

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

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC106A Patterns of Orbital Disease

Participants Deborah R. Shatzkes, MD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

shatzkes@hotmail.com

LEARNING OBJECTIVES

1) Recognize the common cross-sectional imaging patterns that occur in orbital disease. 2) List some of the most important entities that may result in each imaging pattern. 3) Refine the differential diagnosis based on age and clinical presentation.

ABSTRACT

In orbital imaging, it is possible to fit findings into several stereotypical imaging patterns such as enlarged extraocular muscles (EOM), discrete masses, infiltrative processes and bony orbital lesions. Each of these patterns may occur secondary to multiple diseases. For example, enlargement of the EOM occurs most frequently in the setting of thyroid orbitopathy, but also in cases of pseudotumor, lymphoma, metastases, sarcoid and several others. Certain diseases, such as lymphoma, pseudotumor and sarcoid, may present with any of these patterns, and are worth including on most differential lists.

Active Handout:Deborah Rachelle Shatzkes

http://abstract.rsna.org/uploads/2017/17000281/Active RC106A.pdf

RC106B Vision Loss and Diplopia

Participants Jenny K. Hoang, MBBS, Durham, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the anatomy of the visual pathway and type of vision loss. 2) Review anatomy of cranial nerves III, IV, and VI. 3) Discuss approach and differentials for vision and dipopia.

RC106C Ocular Anatomy and Pathology

Participants

Mary Beth E. Cunnane, MD, Boston, MA (Presenter) Nothing to Disclose





RC107

Imaging-based Diagnosis and Management of Urolithiasis (An Interactive Session)

Sunday, Nov. 26 2:00PM - 3:30PM Room: N228

GU

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

Participants

Dushyant V. Sahani, MD, Boston, MA (*Coordinator*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc

Dushyant V. Sahani, MD, Boston, MA (*Moderator*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc

Brian H. Eisner, MD, Boston, MA (*Presenter*) Consultant, Boston Scientific Corporation; Consultant, Retrophin, Inc; Consultant, Allena Pharmaceuticals, Inc; Consultant, Kalera Medical, Inc; Consultant, SonoMotion, Inc; Consultant, Olympus Corporation; Consultant, C. R. Bard, Inc; Owner, Ravine Group

Jennifer W. Uyeda, MD, Boston, MA (*Presenter*) Nothing to Disclose

Dushyant V. Sahani, MD, Boston, MA (*Presenter*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc

Myles T. Taffel, MD, Washington, DC (Presenter) Nothing to Disclose

For information about this presentation, contact:

dsahani@mgh.harvard.edu

LEARNING OBJECTIVES

1) Review five most common kidney stone chemical compositions and recommended medical prophylaxis for each one. 2) Describe imaging techniques for stone diagnosis, including Dual Energy CT techniques. 3) Learn the information that urologists need to know for management and therapy of renal stones. 4) Review updated medical and surgical treatment of renal stones.'

Active Handout: Dushyant V. Sahani

http://abstract.rsna.org/uploads/2017/17000230/Active RC107.pdf

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RC108

Imaging of Musculoskeletal Injuries (An Interactive Session)

Sunday, Nov. 26 2:00PM - 3:30PM Room: E451B

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

For information about this presentation, contact:

manickam.kumaravel@uth.tmc.edu

ABSTRACT

This interactive session will use RSNA Diagnosis Live[™]. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Sub-Events

RC108A Subtle Knee Injuries

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) Recognize subtle knee injury presentations, including soft tissue and bony components of such injury. 2) Understand the pathophysiology of these injuries. 3) Learn to use cross-sectional imaging to further understand their relevance. 4) Correlate the clinical relevance of these subtle injuries, to produce relevant and accurate reports which will impact clinical management.

RC108B Elbow

Participants Adnan M. Sheikh, MD, Ottawa, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize which anatomic structures are most important for maintaining elbow stability. 2) Identify which aspects of elbow injury are most critical for determining treatment method. 3) Understand the most relevant imaging findings of elbow injury using case based approach.

RC108C Hindfoot and Midfoot

Participants Claire K. Sandstrom, MD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize subtle radiographic findings of commonly missed injuries in the mid foot and hind foot. 2) Describe the avulsions in the foot that commonly mimic ankle sprains.

RC108D Fingers

Participants Jonathan A. Flug, MD, MBA, Phoenix, AZ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jonathan.flug@gmail.com

LEARNING OBJECTIVES

1) Detect imaging abnormalities commonly seen in the fingers in the emergency setting. 2) Identify commonly encountered finger pathology in the emergency setting. 3) Recommend appropriate follow up for various findings in the finger in the emergency setting.

ABSTRACT

Radiologists routinely encounter imaging of the fingers in both the general and subspecialty radiology settings. Appropriate recognition of various types of injuries and pathology are crucial for accurate diagnosis and optimal patient care. This interactive lecture will review the various types of pathology the radiologist may encounter in the fingers with an explanation of injury

mechanism and appropriate follow up care.



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RC109

Imaging of the Esophagus, Stomach, and Small Bowel

Sunday, Nov. 26 2:00PM - 3:30PM Room: S404CD

GI

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

FDA Discussions may include off-label uses.

LEARNING OBJECTIVES

1) Draw surgical anatomy of common upper GI tract procedures. 2) Safely prescribe fluoroscopic contrast agents in this postoperative patient population. 3) Correctly diagnosis surgical complications of these procedures. 4) Identify key findings at CT and MR of Crohn's Disease. 5) Clarify GI and Radiologic consensus terminology for findings and their clinical implication. 6) Describe source of imaging pitfalls in the stomach and small bowel including scan and patient related factors and discuss strategies to minimize misses. 7) Identify medications that are known to cause complications in the esophagus, stomach, and small bowel including, but not limited to, chemotherapeutic agents. 8) Utilize CT, MRI, and fluoroscopy to diagnose these complications, typically manifesting with inflammation, ulceration, and perforation. 9) Compare the appearance of these conditions with differential diagnoses such as infection, ischemia, tumor progression, and graft vs. host disease. 10) Assist referring clinicians in guiding treatment, particularly when stratifying patients into operative or non-operative management.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC109A Post-Op Esophagus and Stomach

Participants

Cheri L. Canon, MD, Birmingham, AL (Presenter) Nothing to Disclose

For information about this presentation, contact:

ccanon@uabmc.edu

LEARNING OBJECTIVES

1) Draw surgical anatomy of common upper GI tract procedures. 2) Safely prescribe fluoroscopic contrast agents in this postoperative patient population. 3) Correctly diagnosis surgical complications of these procedures.

RC109B Diagnosing and Reporting of Small Bowel Crohn's Disease

Participants Amy K. Hara, MD, Scottsdale, AZ (*Presenter*) Royalties, General Electric Company;

For information about this presentation, contact:

hara.amy@Mayo.edu

LEARNING OBJECTIVES

1) Identify key findings at CT and MR of Crohn's Disease. 2) Clarify GI and Radiologic consensus terminology for findings and their clinical implication.

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RC109C Common Misses in Imaging of the Stomach and Small Bowel

Participants

Mahmoud M. Al-Hawary, MD, Ann Arbor, MI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe source of imaging pitfalls in the stomach and small bowel including scan and patient related factors and discuss strategies to minimize misses.

RC109D Drug-induced Gastrointestinal Complications: Oncologic and Beyond

Participants

Vincent M. Mellnick, MD, Saint Louis, MO (Presenter) Nothing to Disclose

For information about this presentation, contact:

mellnickv@wustl.edu

LEARNING OBJECTIVES

1) Identify medications that are known to cause complications in the esophagus, stomach, and small bowel including, but not limited to, chemotherapeutic agents. 2) Utilize CT, MRI, and fluoroscopy to diagnose these complications, typically manifesting with inflammation, ulceration, and perforation. 3) Compare the appearance of these conditions with differential diagnoses such as infection, ischemia, tumor progression, and graft vs. host disease. 4) Assist referring clinicians in guiding treatment, particularly when stratifying patients into operative or non-operative management.

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RC110

Liver and Biliary Tree, Including Doppler, Contrast, and Elastography

Sunday, Nov. 26 2:00PM - 3:30PM Room: E353B

GIUS

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

FDA Discussions may include off-label uses.

LEARNING OBJECTIVES

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC110A Liver Doppler Ultrasound

Participants

Mark E. Lockhart, MD, Birmingham, AL (*Presenter*) Author, Oxford University Press; Author, JayPee Brothers Publishers; Deputy Editor, John Wiley & Sons, Inc

LEARNING OBJECTIVES

1) Describe the technique of liver Doppler ultrasound and methods to improve study quality. 2) Review qualitative and quantitative criteria for diagnosing vascular abnormalities in liver ultrasound Doppler examinations.

ABSTRACT

This presentation will initially describe the liver Doppler ultrasound examination with emphasis on techniques to improve study quality. Subsequently, normal Doppler waveforms and threshold values will be reviewed. A variety of abnormal liver Doppler findings will then be discussed in the context of several disease processes. A significant portion of the presentation will revolve around vascular abnormalities associated with liver diseases and evaluation of TIPS shunts will be addressed. Brief discussion of how diagnostic criteria apply to complications of liver transplantation will also be covered.

RC110B Contrast for Liver Masses

Participants

Stephanie R. Wilson, MD, Calgary, AB (*Presenter*) Equipment support, Koninklijke Philips NV; Equipment support, Siemens AG; Equipment support, Samsung Electronics Co, Ltd; Speaker, General Electric Company; Speaker, Koninklijke Philips NV; Speaker, Saumsung

For information about this presentation, contact:

stephanie.wilson@ahs.ca

LEARNING OBJECTIVES

1) To comprehend the value of imaging liver masses with microbubble contrast agents. 2) To understand the mechanism of action of the purely intravascular bubbles as compared with contrast agents for CT and MR scan. 3) To appreciate the advantages afforded by dynamic real time imaging for CEUS showing enhancement regardless of its timing or duration.

RC110C Liver Elastography

Participants

Paul S. Sidhu, MRCP, FRCR, London, United Kingdom (*Presenter*) Speaker, Koninklijke Philips NV; Speaker, Bracco Group; Speaker, Hitachi, Ltd; Speaker, Siemens AG; Speaker, Samsung Electronics Co, Ltd

LEARNING OBJECTIVES

1) Understand the normal anatomy, anatomic variants of the hepatic vasculature. 2) Identify the normal Doppler flow profiles of the hepatic vasculature. 3) Understand the hemodynamic principles of portal hypertension and how they impact the Doppler waveforms of the hepatic arteries, portal veins and hepatic veins. 4) Understand the role of ultrasound in the evaluation of variceal pathways.5) Indications when to use contrast enhanced ultrasound (CEUS) in focal liver diseases. 6) Kinetics of US contrast agents. 7) Learning about the importance of the three contrast phases, how CEUS performs in detecting and characterizing focal liver lesions. 8) Learning about the potential value as well as the limitations of CEUS in liver disease. 9) Learning how CEUS performs when compared to B-mode, color Doppler, CT and MRT imaging. 10) Understand the concept of liver fibrosis grading and the implications for healthcare management. 11) Review the basis for the assessment of liver fibrosis using elastography, with emphasis on the different techniques. 12) Understand the differences in the techniques and the variability in measurement assessment. 13) Achieve and overview of the need and position of this technique in clinical care.

RC110D Acute Cholecystitis, Complications and Mimics

Participants Anthony E. Hanbidge, MBBCh, Toronto, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Anthony.hanbidge@uhn.ca

LEARNING OBJECTIVES

1) Discuss the value of ultrasound in the assessment of acute cholecystitis. 2) Identify the imaging features of acute cholecystitis and its complications. 3) Describe additional pathologic conditions that can confuse the diagnosis.

ABSTRACT

Acute cholecystitis is the most common cause of acute pain in the right upper quadrant (RUQ), and urgent surgical removal of the gallbladder is the treatment of choice for uncomplicated disease. However, cross-sectional imaging is essential because more than one-third of patients with acute RUQ pain do not have acute cholecystitis. In addition, patients with complications of acute cholecystitis, such as perforation, are often best treated with supportive measures initially and elective cholecystectomy later. Ultrasound (US) is the primary imaging modality for assessment of acute RUQ pain; US is both sensitive and specific in demonstrating gallstones, biliary dilatation, and features that suggest acute inflammatory disease. Occasionally, additional imaging modalities are indicated. Computed tomography is valuable, especially for confirming the nature and extent of the complications of acute cholecystitis. Successful imaging requires familiarity with both the characteristic and the unusual features of a wide variety of pathologic conditions. In addition, potential pitfalls must be recognized and avoided.

Active Handout: Anthony Edward Hanbidge

http://abstract.rsna.org/uploads/2017/17000084/Active RC110D.pdf







RC111

PET/CT and SPECT/CT in Movement Disorders, Epilepsy, and Dementia

Sunday, Nov. 26 2:00PM - 3:30PM Room: S505AB



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

FDA Discussions may include off-label uses.

Sub-Events

RC111A Dopamine Transporter Scans and Movement Disorders

Participants

Vani Vijayakumar, MD, Ridgeland, MS (Presenter) Grant, General Electric Company

LEARNING OBJECTIVES

1) Apply basic knowledge and skills relevant to clinical practice of Movement Disorders. 2) Assess the potential of emerging technological innovations and advances to enhance clinical practice and problem-solving. 3) Develop new ideas from experts and peers in the nuclear imaging sciences. 4) Differentiate Essential Tremor and Presynaptic Parkinson Diseases on DATscans. 5) Compare different image findings for interpretation of Movement Disorders.

ABSTRACT

Introduction: Parkinson Disease (PD) is the most common movement disorder affecting 1-2 % of the general population over the age of 65 years and the second most common neurodegenerative disorder after Alzheimer's disease (AD) PD presents with 3 most common symptoms. 1. Resting tremor: Most common first symptom, usually asymmetric and most evident in one hand with the arm at rest. 2. Bradykinesia: Difficulty with daily activities such as writing, shaving, using a knife and fork, and opening buttons; decreased blinking, masked facies, slowed chewing and swallowing. 3. Rigidity: Muscle tone increased in both flexor and extensor muscles providing a constant resistance to passive movements of the joints; stooped posture, anteroflexed head, and flexed knees and elbows. Nuclear Imaging Diagnosis: Datscan: (123I-ioflupane) Patient preparation: Thyroid blockade with Lugols- 3 drops one hour before Stop medicines that bind to the dopamine transporter 7 days prior to study, e.g. SSRIs, amphetamine, benzotropine, cocaine, mazindol, methylphenidate and phentermine and sertraline Radiopharmaceutical: (123I-ioflupane) is a molecular imaging agent 3-5 mCi IV and Brain SPECT in 3 hours Used to demonstrate the location and concentration of dopamine transporters (DaTs) in the synapses of striatal dopaminergic neurons. Interpretation: Normal: comma shaped striatum Abnormal: dot, asymmetric caudate or putamen, high background Summary: A highly sensitive marker for accurate assessment of striatal dopaminergic function to differentiate EssentialTremor from PD Early diagnosis of presynaptic Parkinsonian syndromes Differentiation of presynaptic Parkinsonian syndromes from parkinsonism without presynaptic dopaminergic loss, such as drug-induced parkinsonism or psychogenic parkinsonism A straightforward one-day protocol An objective adjunct to the differentiation of PD syndromes from ET in clinically uncertain patients A diagnostic tool helping differentiate between probable DLB and AD Visualizing DaT distribution is useful as a novel diagnostic adjunct in movement disorders and dementia

Active Handout:Vani Vijayakumar

http://abstract.rsna.org/uploads/2017/16002149/Active RC111A.pdf

RC111B Imaging for Epilepsy

Participants Anson L. Thaggard, MD, Jackson, MS (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

athaggard@umc.edu

LEARNING OBJECTIVES

1) Define the components of a multidisciplinary evaluation for the surgical treatment of epilepsy. 2) Compare brain SPECT with FDG PET for evaluation of an epileptogenic focus. 3) Discuss barriers to the use of ictal SPECT imaging and functional MRI. 4) Appraise the added value of fusion imaging in epilepsy evaluation.

Active Handout: Anson Lee Thaggard

http://abstract.rsna.org/uploads/2017/16002150/Active RC111B.pdf

RC111C PET Imaging for Dementia

Participants

Terence Z. Wong, MD, PhD, Chapel Hill, NC (Presenter) Consultant, Lucerno Dynamics, LLC;

LEARNING OBJECTIVES

1) Understand the basic pathophysiology of Alzheimer's dementia. 2) Distinguish the different roles of PET imaging with FDG, amyloid, and tau tracers for evaluating dementia.

ABSTRACT

Alzheimer's disease is the most common form of dementia affecting the aging population, and is currently the 6th leading cause of death. Clinical diagnosis is difficult, and there is currently no cure. Functional imaging biomarkers may detect early stages of disease prior to the onset of symptoms, and may improve diagnostic accuracy. This in turn may improve evaluation of therapeutic interventions and provide a roadmap toward developing a cure.





RC112

Principles and Applications of 4D Flow MRA

Sunday, Nov. 26 2:00PM - 3:30PM Room: S103CD



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

FDA Discussions may include off-label uses.

Participants

James C. Carr, MD, Chicago, IL (*Moderator*) Research Grant, Astellas Group; Research support, Siemens AG; Speaker, Siemens AG; Advisory Board, Guerbet SA

Ahmed M. Gharib, MBChB, Bethesda, MD (Moderator) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand basic principles of 4D flow MRI data acquisition. 2) Identify different variants of 4D flow sequences. 3) Explain methods for the 3D visualization and quantification of cardiovascular flow data acquired by 4D flow MRI. 4) To know components required to implement clinically 4D flow. 5) To know types of clinically relevant data that can be extracted from 4D flow. 6) Become familiar with approaches to integrating 4D flow into clinical protocols. 7) Review clinical scenarios where 4D flow may aid in the management of patients with cardiac and aortic disease. 8) Assess current data on emerging clinical applications of 4D flow in the chest. 9) Review 4D Flow-derived parameters that show promise for risk stratification. 10) Understand the underlying principles of phase velocity MRA. 11) Be familiar with the currently available methods for phase velocity MRA. 12) Be familiar with important applications and examples of phase velocity MRA. 13) Understand current limitations and pitfalls associated with phase velocity MRA. 14) Be familiar with emerging applications of 4D flow MRI in the abdomen. 15) Develop a clinical protocol to generate 4DFlow images of the intracranial circulation. 16) Recognize the flow features of intracranial arterial stenosis and aneurysms. 17) Apply 4DFlow to precisely define AVM hemodynamics. 18) Develop an integrated approach to venous outflow assessment.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC112A Technical Principles and Solutions

Participants

Michael Markl, PhD, Chicago, IL (*Presenter*) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;

LEARNING OBJECTIVES

1) Understand basic principles of 4D flow MRI data acquisition. 2) Identify different variants of 4D flow sequences. 3) Explain methods for the 3D visualization and quantification of cardiovascular flow data acquired by 4D flow MRI.

ABSTRACT

The intrinsic motion sensitivity of magnetic resonance imaging (MRI) can be used acquire and quantify blood flow. 4D flow MRI can be employed to encode blood flow velocities along all dimensions and offers the possibility to acquire spatially registered information on three-directional blood flow simultaneously with the 3D anatomic data within a single examination. As a result, 4D flow MRI permits the assessment of three-directional blood flow with full volumetric coverage of cardiac chambers or cardio- or neurovascular regions of interest such as the thoracic aorta or the large cerebral arterial and venous system. A benefit compared to traditional imaging techniques is related to the possibility to visualize cardiac and vascular hemodynamics and retrospectively quantify blood flow at any location of interest. In addition to the 3D visualization of complex cardiac and vascular flow patterns, quantitative flow analysis can provide quantitative information on the impact of cardio- or neurovascular pathologies on altered hemodynamics associated with the presence of cardio- and neurovascular disease. The presentation will1) Introduce methodological aspects related to the measurement of 3D blood in the human body based on 4D flow MRI;2) Illustrate the potential of 4D flow MRI for the 3D visualization and quantification of cardiovascular hemodynamics;3) Provide examples of clinically relevant questions and how 4D flow can be used to improve cardiovascular diagnostics.

RC112B Clinical Workflow and Implementation

Participants

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

LEARNING OBJECTIVES

1) To know components required to implement clinically 4D flow. 2) To know types of clinically relevant data that can be extracted from 4D flow. 3) Become familiar with approaches to integrating 4D flow into clinical protocols.

ABSTRACT

implement 4D flow in a clinical setting, review types of clinically relevant data that can be extracted from 4D flow, and present several approaches to integrating 4D flow into clinical MRI protocols. Essential components include a pulse sequence and postprocessing software. Data that can be extracted includes blood flow, cardiovascular function, and anatomy. Protocols can be greatly simplified with 4D flow, enabling a decoupling of image acquisition and interpretation, thereby enhancing efficiency of patient, technologist, and radiologist time.

RC112C Chest Applications

Participants

Michael D. Hope, MD, San Francisco, CA (Presenter) Nothing to Disclose

For information about this presentation, contact:

michael.hope@ucsf.edu

LEARNING OBJECTIVES

1) Review clinical scenarios where 4D flow may aid in the management of patients with cardiac and aortic disease. 2) Assess current data on emerging clinical applications of 4D flow in the chest. 3) Review 4D Flow-derived parameters that show promise for risk stratification.

ABSTRACT

We will focus on the emerging applications of multidimensional MR flow imaging (4D Flow) in the chest. The techniques and hemodynamic biomarkers that we will discuss can be applied broadly throughout the cardiovascular system. Two key issues must be addressed when considering these applications: 1) clear advantages over conventional imaging and 2) matching advanced imaging capabilities with clinical questions that change the management of patients with cardiac and aortic disease. The goal is to provide a unique understanding of how abnormal flow promotes or exacerbates disease. This understanding, in turn, could allow patients to be risk-stratified based on flow, guide medical therapy, and identify new pathways to target with drug therapy and patients that may benefit from early intervention.

RC112D Abdominal Applications

Participants

Scott B. Reeder, MD, PhD, Madison, WI (*Presenter*) Institutional research support, General Electric Company; Institutional research support, Bracco Group; Founder, Calimetrix, LLC; Shareholder, Elucent Medical

LEARNING OBJECTIVES

1) Understand the underlying principles of phase velocity MRA. 2) Be familiar with the currently available methods for phase velocity MRA. 3) Be familiar with important applications and examples of phase velocity MRA. 4) Understand current limitations and pitfalls associated with phase velocity MRA. 5) Be familiar with emerging applications of 4D flow MRI in the abdomen.

RC112E Cerebrovascular Applications

Participants

Patrick A. Turski, MD, Madison, WI (Presenter) Institutional Research support, General Electric Company

LEARNING OBJECTIVES

1) Develop a clinical protocol to generate 4DFlow images of the intracranial circulation. 2) Recognize the flow features of intracranial arterial stenosis and aneurysms. 3) Apply 4DFlow to precisely define AVM hemodynamics. 4) Develop an integrated approach to venous outflow assessment.

ABSTRACT

Accelerated 4DFlow MRI acquisition and reconstruction methods are now available to provide high resolution exams in clinically relevant imaging times. 4DFlow MRI not only provides images of vascular morphology but also acquires quantitative measurements of velocity throughout the imaging volume. Hemodynamic parameters such as flow volume, relative wall shear stress, streamlines, vorticity and pressure gradients can be derived from the velocity data. The combination of anatomical imaging, lumen visualization and physiological data derived from accelerated 4DFlow MRI augments the characterization of intracranial arterial stenosis, aneurysms, vascular malformations and dural sinus pathology. This presentation provides an update for radiologists interested in cerebrovascular applications of 4DFlow MRI.




RC113

Pediatric Series: Fetal/Neonatal Imaging

Sunday, Nov. 26 2:00PM - 3:30PM Room: S102CD



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

FDA Discussions may include off-label uses.

Participants

Amy R. Mehollin-Ray, MD, Houston, TX (*Moderator*) Nothing to Disclose Erika Rubesova, MD, MSc, Stanford, CA (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

armeholl@texaschildrens.org

Sub-Events

RC113-01 Imaging of Congenital Diaphragmatic Hernia

Sunday, Nov. 26 2:00PM - 2:20PM Room: S102CD

Participants Amy R. Mehollin-Ray, MD, Houston, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

armeholl@texaschildrens.org

LEARNING OBJECTIVES

1) Distinguish the various subtypes of fetal diaphragmatic hernia using both ultrasound and MRI. 2) Learn to measure lung-head ratio, total fetal lung volume and percent liver herniation and apply those values to determine prognosis. 3) Utilize fetal imaging to identify candidates for fetal and postnatal therapies for congenital diaphragmatic hernia. 4.) Review expected and unexpected postnatal radiographic findings in newborns with diaphragmatic hernia.

RC113-02 Gadolinium Dose Reduction and Fetal Sparing Using a Hyper-Relaxive T1 Contrast Agent

Sunday, Nov. 26 2:20PM - 2:30PM Room: S102CD

Participants

Ketan B. Ghaghada, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Zbigniew Starosolski, PhD, Houston, TX (*Presenter*) Stockholder, Alzeca Biosciences, LLC
Igor Stupin, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Chandresh Patel, BS, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Rohan Bhavane, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Sensulin, LLC
Haijun Gao, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Flavia Lea Barbosa, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Chandra Yallampalli, DVM,PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Verghese George, MBBS, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Ananth Annapragada, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Alzeca Biosciences, LLC; Stockholder, Sensulin, LLC;

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PURPOSE

The recent PRAC recommendation to the EMA fortifies the wisdom of minimizing gadolinium (Gd) dose. This is of particular importance in pregnancy, where Gd contrast could be very useful in the diagnosis of morbidly adherent placenta, but is rarely used, due to the risks of fetal exposure. In this pre-clinical study, we investigated the minimum dose of a hyper-T1 relaxive liposomal-Gd blood-pool contrast agent, that has been shown to not permeate the placental barrier, for MRI of the placenta.

METHOD AND MATERIALS

In vitro studies were performed to compare T1 relaxivity of liposomal-Gd and a conventional Gd agent. In vivo studies were performed in pregnant rats on a 1T MR scanner. Non-contrast images were acquired followed by administration of liposomal-Gd (at doses from 0.05-0.15 mmol Gd/kg). Post-contrast images were obtained using a GRE sequence. Additionally, four consecutive high-resolution 3D images, with long scan times, were acquired for assessing improvement in placental margin visualization. SNR and CNR were calculated on all images. Images were reviewed and scored by a radiologist. Post-mortem tissue analysis was performed for determining transplacental permeation of liposomal-Gd.

Liposomal-Gd demonstrated 5-fold higher T1 relaxivity compared to conventional Gd. In vivo MRI demonstrated visualization of placenta and retroplacental space, at dose as low as 0.05 mmol Gd/kg. Improvement in image quality was further evident from significantly higher post-contrast CNR values (Non-contrast= 2 + -1; 0.05 mmol Gd/kg= 17 + -6; 0.10 mmol Gd/kg= 23 + -4; 0.15 mmol Gd/kg= 25 + -7). The long blood circulation half-life of the agent enabled prolonged scanning without bolus-timing limitations. Multiple high-resolution images could be acquired without loss in image quality or the need for additional contrast agent dosing. Residual Gd analysis in placental and fetal tissues confirmed absence of transplacental transport of liposomal-Gd.

CONCLUSION

The high T1 relaxivity of liposomal-Gd agent enabled visualization of placenta and its margins, both at a lower dose and at higher spatial resolution. Contrast agent dose as low as 0.05 mmol Gd/kg was adequate for visualization of placenta.

CLINICAL RELEVANCE/APPLICATION

Placental imaging using a low dose of hyper-T1 relaxive liposomal-Gd agent that does not cross the placental barrier offers promise in clinical contrast-enhanced MRI evaluation of placenta accreta and its variants.

RC113-03 Postmortem MRI and Histological Correlation of the Rostral Migratory Stream in the Human Fetal Brain

Sunday, Nov. 26 2:30PM - 2:40PM Room: S102CD

Participants

Christian Mitter, MD, Vienna, Austria (*Presenter*) Nothing to Disclose Peter C. Brugger, MD, PhD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose Ivana Pogledic, MD, PhD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose Gerlinde Gruber, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose Dieter Bettelheim, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose Johannes Hainfellner, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose Daniela Prayer, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose Gregor Kasprian, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The rostral migratory stream (RMS) projects along an extension of the lateral ventricle to the olfactory bulb and constitutes the main migration pathway of neural progenitor cells from the subventricular zone to the olfactory bulb. It has been extensively researched in the rodent brain due to its implication in adult neurogenesis and has also been described in histological studies of both the adult and fetal human brain. The purpose of our study was to investigate the MRI appearance of the RMS in the human fetal brain using postmortem 3T MRI and to correlate our imaging findings with histology in identical subjects.

METHOD AND MATERIALS

We included 10 human fetuses between 16 and 25 gestational weeks without gross cerebral malformations. Postmortem MR imaging was performed within 24h after fetal demise as part of routine virtual autopsy examinations. The RMS was delineated on orthogonal T2w sequences. Neuropathological autopsy was available in 6/10 cases, which enabled correlation of imaging findings with histology.

RESULTS

The RMS was identified in all 10/10 subjects as a T2-hypointense extension of the ganglionic eminence. It was found to project as a flattened structure rostral of the caudate nucleus from the bottom of the anterior horn of the lateral ventricle ventrocaudal towards the base of the olfactory peduncle where it angulated rostral into the horizontal plane to continue into the olfactory bulb. Histological sections at multiple levels confirmed the postmortem MR findings of a flattened RMS configuration, its projection path and its high cell density, as indicated by its low signal on T2w images.

CONCLUSION

The RMS is a prominent structure in the second trimester human fetal brain and can be reliably depicted as a T2-hypointense extension of the ganglionic eminence on 3T postmortem MRI due to its high cell density.

CLINICAL RELEVANCE/APPLICATION

The postmortem MR anatomy of the RMS may be of value as a reference for in vivo studies, as early trials indicate that the RMS could potentially be depicted in utero by 3T fetal MRI.

RC113-04 MR Imaging of Retroplacental Clear Space in a Pregnant Rat Model

Sunday, Nov. 26 2:40PM - 2:50PM Room: S102CD

Participants

Ketan B. Ghaghada, PhD, Houston, TX (*Presenter*) Nothing to Disclose Zbigniew Starosolski, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Alzeca Biosciences, LLC Igor Stupin, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Chandresh Patel, BS, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Rohan Bhavane, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Sensulin, LLC Flavia Lea Barbosa, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Haijun Gao, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Chandra Yallampalli, DVM,PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Verghese George, MBBS, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Ananth Annapragada, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Stockholder, Abbott Laboratories; Stockholder, Johnson & Johnson;

For information about this presentation, contact:

kbghagha@texaschildrens.org

PURPOSE

Clear visualization of placental margins, specifically the retroplacental clear space, is critical to the accurate diagnosis of invasive placentation. Consistent and reproducible visualization of retroplacental space in clinical subjects has not been reported in the literature. In this pre-clinical study, we investigated if a liposomal-Gd blood-pool contrast agent, that has been shown to not penetrate the placental barrier, would enable MR visualization of the retroplacental space. Non-contrast MRI and contrast-enhanced MRI using a clinically approved contrast agent, gadoterate meglumine, were used as comparators.

METHOD AND MATERIALS

Studies were performed in pregnant rats on a 1T MRI scanner. DCE-MRI with gadoterate meglumine was performed using a GRE sequence. Non-contrast images were acquired followed by bolus administration of gadoterate meglumine and 20 minutes of post-contrast imaging. Liposomal-Gd was administered and imaging was performed a minimum of three hours later, insuring clearance of gadoterate meglumine. CNR were calculated for non-contrast, conventional Gd and liposomal-Gd enhanced images. A radiologist reviewed the images to score the visualization of the retroplacental space.

RESULTS

Non-contrast images demonstrated poor visualization of the placenta; the retroplacental space was not visible. DCE-MRI with the conventional Gd demonstrated retrograde opacification of placenta from fetal edge towards myometrium. However, no consistent and reproducible visualization of space was demonstrated in conventional Gd images acquired over 20 minute. Liposomal-Gd demonstrated clear visualization of placenta and retroplacental space. CNR analysis demonstrated significantly improved placenta and its margin visualization with liposomal-Gd compared to conventional agent (25 +/- 7 vs. 15 +/-3). The prolonged opacification of blood pool facilitated longer acquisition of high-resolution 3D images that further enabled excellent visualization of the retroplacental clear space.

CONCLUSION

CE-MRI using liposomal-Gd enabled clear visualization of the retroplacental clear space in a pregnant rat model; the clear space was otherwise undetectable on non-contrast or conventional Gd-enhanced MRI.

CLINICAL RELEVANCE/APPLICATION

Visualization of retroplacental space using a liposomal-Gd blood-pool contrast agent that does not cross the placental barrier offers promise in clinical contrast-enhanced MRI evaluation of morbidly adherent placenta.

RC113-05 Evaluation of Brain Injury in Neonates by Magnetization Transfer Imaging Combined Amide Proton Transfer Imaging: A Preliminary Study

Sunday, Nov. 26 2:50PM - 3:00PM Room: S102CD

Participants

Yang Zheng, Shenyang, China (*Presenter*) Nothing to Disclose

Xiaoming Wang, MD, Shenyang, China (Abstract Co-Author) Nothing to Disclose

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PURPOSE

To evaluate neonatal brain injury at the internal environmental level with the application of amide proton transfer (APT) imaging and magnetization transfer imaging by measuring the APT and MTR values of the brain.

METHOD AND MATERIALS

A total of 38 neonatal patients who underwent MR examination were enrolled in the study. Among them, there were 25 newborns with no abnormalities and 13 cases with brain injury who underwent conventional MR (T1WI, T2WI, DWI) examination. After obtaining informed consent and permission of clinicians, routine MR was followed by additional APT/MT scan. APT/MT imaging is single slice scanning, performed at the basal ganglia level in all neonates, and in the case group, with increased localization at the level of lesion, and with the contralateral relatively normal area as self-control. The APT/MTR values of bilateral frontal subcortical white matter, basal ganglia and occipital subcortical white matter were measured for all neonates, as well as the APT/MTR values of the lesion and contralateral areas. Several statistical methods were used for statistical analysis.

RESULTS

In the control group, bilateral frontal subcortical white matter, basal ganglia and occipital subcortical white matter had no significant difference in APT/MTR value (P>0.05). Between the different parts of the brain, the differences among the APT/MTR of the frontal lobes, basal ganglia, and occipital lobes were significant, P<0.05. In addition, the APT/MTR of the above brain regions were found to have a positive correlation with gestational age. In the case group, there were significant differences in APT values between the lesion side and contralateral area, being significantly lower in lesion side than the contralateral side (P<0.05).

CONCLUSION

From changes in the pH level in the neonatal brain, APT/MT imaging can help understand neonatal brain injury.

CLINICAL RELEVANCE/APPLICATION

Magnetization transfer (MT) imaging amide proton transfer (APT) imaging is a noninvasive imaging method of MR, and it is capable of detecting mobile cellular proteins and peptides and monitoring pH effects.

RC113-06 Real-Time Virtual Sonography: A New Integrated Approach for the Evaluation of Fetal Cerebral Pathologies?

Sunday, Nov. 26 3:00PM - 3:10PM Room: S102CD

Student Travel Stipend Award

Participants

Silvia Bernardo, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Amanda Antonelli, MD, Rome, Italy (*Presenter*) Nothing to Disclose Valeria Vinci, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Federica Capozza, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Lucia Manganaro, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Real-time virtual sonography (RVS) is a new technique that uses magnetic navigation and computer software for the synchronized display of real-time US and multiplanar reconstruction MRI images. The purpose of this study was to evaluate the feasibility and ability of RVS to assess the main cerebral pathologies in fetuses with suspected US anomalies.

METHOD AND MATERIALS

This is a prospective study. Fusion imaging (Hitachi HI Vision Ascendus) was offered to 35 patients undergone Fetal MRI for a US suspicion of cerebral pathology. The MRI image dataset acquired was loaded into the fusion system using a CD support and displayed together with the US image. Both sets of images were then manually synchronized and images were registered. The possibility to record the images in a video format allowed, however, the possibility to re-evaluated the examination.

RESULTS

RVS was technically possible in all cases . Data registration, matching and fusion imaging were performed in 25 minutes at the beginning and in less than 15-20 minutes after practice. The ability of RVS imaging to assess the main anatomical sites and fetal anomalies was evaluated and compared with standard US and MRI images. The principal application of RVS was the study of midline, cerebral gyration and vascular malformations because it also allowed adding a real time Doppler signal on MRI images. Fusion imaging helped the diagnosis in 25%. In the 25/35 cases of encephalic pathology, fusion imaging improved the diagnosis; in the other cases MRI was superior to US even using the RVS.

CONCLUSION

This is a preliminary study on the feasibility and practical use of a Fetal MRI-US real-time fusion imaging. Both techniques are complementary but still independent and the retrospective synthesis of these exams allows optimal analysis of fetal cerebral anomalies.

CLINICAL RELEVANCE/APPLICATION

This technique has many advantages especially on the pedagogic plan. However, RVS is currently limited to the research area.

RC113-07 Prenatal and Postnatal Imaging of Bowel Obstruction

Sunday, Nov. 26 3:10PM - 3:30PM Room: S102CD

Participants Erika Rubesova, MD, MSc, Stanford, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rubesova@stanford.edu

LEARNING OBJECTIVES

The objective of this talk is to present the most common and some rare manifestation of bowel obstruction in the fetus and in the neonate. After the talk, the learner should be able to recognize normal appearance of bowel in the fetus and neonate from abnormal fetal bowel distention on ultrasound, MRI and plain films. The course will provide tools to differentiate proximal form distal obstruction in the fetus on prenatal ultrasound and MRI. The course will be illustrated by examples of common and less common bowel obstructions and their radiological presentations in the fetus and neonate.

LEARNING OBJECTIVES

1) To explain the developmental and acquired mechanisms for bowel obstruction in the fetus and the neonate. The speaker will cover the imaging manifestation of various common and rare ethiologies of bowel obstruction. The most appropriate modalities to diagnose and localize the obstruction will be discussed, including fetal ultrasound, fetal and fluoroscopic studies and postnatal MRI. The speaker will also cover the advances in these modalities to better diagnose and predict outcome of the fetus/neonate.







RC114

Morbidity and Mortality

Sunday, Nov. 26 2:00PM - 3:30PM Room: S504AB

IR

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

Participants

Sanjay Misra, MD, Rochester, MN (*Moderator*) Cordis/Flexstent; NIH funding Michael D. Darcy, MD, Saint Louis, MO (*Moderator*) Nothing to Disclose

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC114A Oncologic M & M

Participants Eric J. Hohenwalter, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

eho@mcw.edu

LEARNING OBJECTIVES

1. Recognize complications in IR. 2. Discuss management of IR complications. 3. Discuss strategies to avoid potential complications.

RC114B Memorable M & M Cases

Participants

Michael D. Darcy, MD, Saint Louis, MO (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how errors in judgement can contribute to complications. 2) Understand how perception failures can contribute to complications. 3) Understand how to recognize serious complications. 4) Understand how to manage complications in IR.

RC114C Vascular M & M

Participants Sanjay Misra, MD, Rochester, MN (*Presenter*) Cordis/Flexstent; NIH funding

LEARNING OBJECTIVES

1) Identify arterial and venous vascular complications. 2) Describe management of the complications. 3) Discuss strategies to avoid complications.

RC114D Nonvascular M & M

Participants

Brian S. Funaki, MD, Chicago, IL (Presenter) Data Safety Monitoring Board, Novate Medical Ltd







Breast MR Imaging (Interactive Session)

Sunday, Nov. 26 2:00PM - 3:30PM Room: E353C



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

Participants

Cherie M. Kuzmiak, DO, Chapel Hill, NC (Moderator) Nothing to Disclose

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC115A Scanning Wisely: MRI Protocols

Participants Jean M. Seely, MD, Ottawa, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jeseely@toh.ca

LEARNING OBJECTIVES

Recognize and discuss the appropriate indications for breast MRI.
 Understand the basic requirements to perform breast MRI.
 Recognize the importance of good positioning to minimize artifacts that may lead to errors in interpretation.
 Be aware of some advanced techniques in breast MRI.

ABSTRACT

Using a case-based approach, this interactive session will review the appropriate indications for breast MRI and basic requirements to perform quality breast MRI. It will highlight the importance of good positioning to improve interpretation and minimize artifacts associated with poor technique. An overview will also be provided of some recent advanced MRI techniques.

RC115B MRI BIRADS 3

Participants

Debra M. Ikeda, MD, Stanford, CA (Presenter) Scientific Advisory Board, Grail, Inc; Case Reviewer, Siemens Inc.

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LEARNING OBJECTIVES

1) Improve basic knowledge of Breast MRI BIRADS Category 3 scientific literature. 2) Recognize and discuss the appropriate indications for Breast MRI BIRADS Category 3 selection. 3) Apply principles of BIRADS 3 Category literature to case examples for use in clinical practice.

ABSTRACT

Using a case-based approach, this session will provide an analysis of the Breast MRI BIRADS 3 scientific literature, and review appropriate and inappropriate use of the BIRADS 3 category. Using this knowledge, participants will be able to apply principles of Breast MRI BIRADS 3 lesion selection to avoid pitfalls of inappropriate BIRADS 3 assignment and misdiagnosis of cancers.

RC115C Challenging Cases

Participants

Eric L. Rosen, MD, Denver , CO (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To review a series of challenging breast MRI cases encountered in a busy breast imaging center, offering pragmatic evidence based recommendations while emphasizing appropriate BIRADS usage, a working knowledge of the updated AJCC breast cancer staging guidlines and attention to detail. At the end of this session the lerner will have a better understanding of breast cancer staging and the important clinical role MRI plays in the evaluation of both high risk patients, those with silicone implant augmentation, and those newly diagnosed with breast cancer

ABSTRACT

Using a case-based approach, this session will review a series of challenging MRI cases encountered in a busy academic practice, reviewing scenarios including high risk screening, implant evaluation, newly diagnosed and recourrent breast cancer. Appropriate

BIRADS usage, NCCN guidlines and AJCC staging guidelines will be addressed and illustrated to inform the lerner of important updates relevant to their practice to aviod diagnostic delays, blunders and misses.







RC116

Developing Competency in Non-Clinical Professional Roles in Radiology and Medicine (Sponsored by the RSNA Professionalism Committee)

Sunday, Nov. 26 2:00PM - 3:30PM Room: S103AB



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

Participants

Stephen Chan, MD, Closter, NJ (*Moderator*) Nothing to Disclose Kyongtae T. Bae, MD, PhD, Pittsburgh, PA (*Presenter*) Patent agreement, Bayer AG Patent agreement, Guerbet SA Patent agreement, Nemoto Kyorindo Co, Ltd Ronald L. Eisenberg, MD, JD, Boston, MA (*Presenter*) Nothing to Disclose Geraldine B. McGinty, MD, MBA, New York, NY (*Presenter*) Nothing to Disclose Suresh K. Mukherji, MD, Northville, MI (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe different non-clinical professional roles of the radiologist, and the various kinds of training and experience required to develop expertise in these roles. 2) Deepen their understanding of specific professional roles - such as study section reviewer and expert witness - where radiologists bring specific subspecialty expertise into non-clinical professional realms. 3) Develop their appreciation of the role of business and leadership skills in representing the radiology profession within various healthcare organizations, and within governmental bodies, panels and agencies both inside and outside the healthcare arena.

ABSTRACT

By virtue of the importance of radiology in modern medicine, as well as of the clinical, academic, and scientific expertise that every radiologist develops as a result of his or her years of training and experience, many individuals in the field of radiology are called upon to participate in professional activities for which he or she has NOT typically received formal training of similar intensity and duration. The performance of such non-clinical activities at a suitable professional level is important for promoting and enhancing the careers of individual radiologists. In addition, pursuit of these non-clinical activities is also essential for enhancing the overall image of the radiology profession as relevant, connected, and integral to the practice of modern medicine, and for demonstrating radiologists to be contributing, functional members of society. As a group, the presenters will cover several, important non-clinical professional roles, and each will discuss how radiologists and other healthcare professionals can develop the acumen to succeed in a non-clinical professional role that requires a different type of expertise and is associated with a different set of expectations.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Ronald L. Eisenberg, MD, JD - 2012 Honored EducatorRonald L. Eisenberg, MD, JD - 2014 Honored Educator







Emerging Technology: PET/MRI - Opportunities and Challenges

Sunday, Nov. 26 2:00PM - 3:30PM Room: S504CD



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

FDA Discussions may include off-label uses.

Participants

Rathan M. Subramaniam, MD, PhD, Dallas, TX (Moderator) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss opportunities of PET/MRI in clinical practice and research. 2) To discuss challenges of PET/MRI in clinical practice and research.

Sub-Events

RC117A PET/MRI: The Evolving Imaging Field of Structure and Function

Participants

Rathan M. Subramaniam, MD, PhD, Dallas, TX (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss the status of PET/MRI in clinical practice in 2017 and the opportunities and challenges in implementation.

RC117B PET/MRI Physics: The Opportunities and Challenges

Participants

Georges El Fakhri, PhD, Boston, MA (Presenter) Nothing to Disclose

RC117C PET/MRI Clinical Applications: Brain and Head and Neck

Participants

Alexander Drzezga, MD, Cologne, Germany (*Presenter*) Consultant, Siemens AG; Consultant, Bayer AG; Consultant, General Electric Company; Consultant, Eli Lilly and Company; Consultant, The Piramal Group; Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG; Speakers Bureau, General Electric Company; Speakers Bureau, Eli Lilly and Company; Speakers Bureau, The Piramal Group

LEARNING OBJECTIVES

1) Review relevant clinical applications for PET/MR in the diagnostic work-up of disorders of the brain. 2) Review strengths of PET/MR for disorders of the head and neck. 3) Understand the value of different currently available tracers for neuroimaging and oncological applications. 4) Review challenges and limitations of PET/MR in brain/head&neck and expected future developments.

RC117D PET/MRI Clinical Applications: Body

Participants

Thomas A. Hope, MD, San Francisco, CA (Presenter) Research Support, GE Healhtcare

For information about this presentation, contact:

thomas.hope@ucsf.edu

LEARNING OBJECTIVES

1) Review common current applications for abdominopelvic oncologic PET/MRI, including hepatic malignancies, rectal cancer, and cervical cancer. 2) Understand the role of novel tracers in prostate cancer (PSMA PET) and neuroendocrine tumors (somatostatin receptor PET). 3) Present the current limitations and future advances in PET/MRI that will help increase the clinical acceptance and applicability of body PET/MRI.

RC117E PET/MRI Clinical Applications: Cardiac

Participants

Pamela K. Woodard, MD, Saint Louis, MO (*Presenter*) Research agreement, Siemens AG; Research, Eli Lilly and Company; Research, F. Hoffmann-La Roche Ltd; ; ; ; ;

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woodardp@mir.wustl.edu

LEARNING OBJECTIVES

1) Discuss clinical cardiac PET/MR imaging applications; applications will include myocardial perfusion and viability, nonischemic

cardiomyopathy, and tumor assessment.







Multidisciplinary Communication in Cancer Care: Talking the Same Language

Sunday, Nov. 26 2:00PM - 3:30PM Room: N230B

OI IN

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

Participants

Hebert Alberto Vargas, MD, New York, NY (Moderator) Nothing to Disclose

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC118A Structured Reporting in Oncology: Pearls and Pitfalls

Participants

Hebert Alberto Vargas, MD, New York, NY (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Become familiar with the definition of "structured reporting" and the differences between structure and accuracy of reports' content. 2) Discuss the advantages of structured reporting emphasizing its impact of clear and effective communication of imaging findings. 3) Emphasize the importance of standardizing terminology and the expression of diagnostic certainty in structured reports.

RC118B The Impact of Subspecialty Reading on Patient Management

Participants

Fergus V. Coakley, MD, Portland, OR (Presenter) Founder, OmnEcoil Instruments, Inc; Shareholder, OmnEcoil Instruments, Inc

For information about this presentation, contact:

coakleyf@ohsu.edu

LEARNING OBJECTIVES

1) Review the importance and context of radiology interpretation to patient management. 2) Describe the available data on the incremental benefit of subspecialist interpretation.

RC118C Proliferation of Tumor Boards: Should Radiology Departments Support Them All?

Participants

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







The Role of PET/MR Metabolic Imaging in Improving Oncology Outcomes

Sunday, Nov. 26 2:00PM - 3:30PM Room: E353A



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

FDA Discussions may include off-label uses.

Participants

Christina I. Tsien, MD, Saint Louis, MO (Moderator) Speaker, Merck & Co, Inc

Sub-Events

RC120A PET Imaging of Metabolism and Downstream Targets

Participants

Kooresh I. Shoghi, PhD, St. Louis, MO (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Highlight the significance of metabolic imaging. 2) Provide an overview of PET tracers for metabolic imaging. 3) Discuss the role and applications of metabolic imaging in translational research.

RC120B MR Imaging

Participants

Tammie S. Benzinger, MD, PhD, Saint Louis, MO (*Presenter*) Research Grant, Eli Lilly and Company; Investigator, Eli Lilly and Company; Investigator, F. Hoffmann-La Roche Ltd;

For information about this presentation, contact:

benzingert@WUSTL.EDU

LEARNING OBJECTIVES

1) State of the art MR measures of metabolism, applications to radiation oncology patients. 2) What can metabolic MR measures tell us about tumor biology in vivo? 3) What is the potential role of metabolic MR in treatment monitoring?

RC120C H/N and Prostate Cancer

Participants

Anca L. Grosu, MD, Freiburg, Germany (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe new developments of PET/MR Imaging for staging patients with primary and recurrent prostate cancer and to address possible implications for treatment planning. 2) Evaluate new developments of PET/MR Imaging for staging patients with H/N cancer and to address possible implications for treatment planning.

ABSTRACT

Staging has a crucial role in patients with prostate cancer, since it allows distinguishing between localized and disseminated disease. Reliable imaging is the door opener for local therapy approaches in patients with prostate cancer. In patients with H/N cancer the combination of MRI (perfusion) and PET/CT (hypoxia) information is able to detect therapy resistant subvolumes which correlate with treatment outcome. This talk will discuss new developments in Molecular/Functional Imaging for prostate cancer and H/N patients and the possible implications for radiation treatment planning.

RC120D CNS and Lung Cancer

Participants

Daniel R. Wahl, MD, PhD, Ann Arbor, MI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand emerging metabolic imaging techniques for CNS malignancies and their clinical applications. 2) To understand emerging metabolic imaging techniquest for lung cancers and their clinical applications.



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103rd Scientific Assembly and Annual Meeting November 26 to December 1 McCormick Place, Chicago



RC121

Advances in CT: Technologies, Applications, Operations-CT System Advances

Sunday, Nov. 26 2:00PM - 3:30PM Room: E352

СТ РН

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

FDA Discussions may include off-label uses.

Participants

Ehsan Samei, PhD, Durham, NC (*Coordinator*) Research Grant, General Electric Company; ; Research Grant, Siemens AG; ; Advisory Board, medInt Holdings, LLC

Norbert J. Pelc, DSc, Stanford, CA (*Coordinator*) Research support, Koninklijke Philips NV; Research support, General Electric Company; Research support, Siemens AG; Consultant, Varian Medical Systems, Inc; Consultant, NanoX; Scientific Advisory Board, RefleXion Medical Inc; Scientific Advisory Board, Prismatic Sensors AB; Scientific Advisory Board, Theranos, Inc; Medical Advisory Board, OurCrowd, LP

For information about this presentation, contact:

samei@duke.edu

LEARNING OBJECTIVES

1) Recognize the various forms of open gantry systems for volumetric CT, including C-arms and similar systems for interventional and diagnostic imaging. 2) Understand the image quality characteristics of such systems, including advantages and challenges associated with volumetric (cone-beam) CT. 3) Understand the clinical applications of such systems in interventional and diagnostic imaging. 4) Describe some of the latest CT acquisition techniques, including high pitch, gating, dynamic (shuttle), and automatic kV selection. 5) Explain the clinical applications of these novel acquisition techniques.

Sub-Events

RC121A Closed Gantry Systems Advances in X-ray Sources and Detectors

Participants

Norbert J. Pelc, DSc, Stanford, CA (*Presenter*) Research support, Koninklijke Philips NV; Research support, General Electric Company; Research support, Siemens AG; Consultant, Varian Medical Systems, Inc; Consultant, NanoX; Scientific Advisory Board, RefleXion Medical Inc; Scientific Advisory Board, Prismatic Sensors AB; Scientific Advisory Board, Theranos, Inc; Medical Advisory Board, OurCrowd, LP

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC121B Open Gantry Systems: Advances, Challenges, and New Applications

Participants

Jeffrey H. Siewerdsen, PhD, Baltimore, MD (*Presenter*) Research Grant, Siemens AG; Research Grant, Carestream Health, Inc; Advisory Board, Siemens AG; Advisory Board, Carestream Health, Inc; License agreement, Carestream Health, Inc; License agreement, Precision X-Ray, Inc; License agreement, Elekta AB; ; ;

For information about this presentation, contact:

jeff.siewerdsen@jhu.edu

LEARNING OBJECTIVES

1) Recognize the various forms of open gantry systems for volumetric CT, including C-arms and similar systems for interventional and diagnostic imaging. 2) Understand the image quality characteristics of such systems, including advantages and challenges associated with volumetric (cone-beam) CT. 3) Understand the clinical applications of such systems in interventional and diagnostic imaging.

RC121C Novel CT Acquisition Techniques

Participants

Lifeng Yu, PhD, Chicago, IL (Presenter) Nothing to Disclose

For information about this presentation, contact:

yu.lifeng@mayo.edu

LEARNING OBJECTIVES

1) Describe some of the latest CT acquisition techniques, including high pitch, gating, dynamic (shuttle), and automatic kV selection. 2) Explain the clinical applications of these novel acquisition techniques.







Imaging for Personalized Medicine: Head and Neck

Sunday, Nov. 26 2:00PM - 3:30PM Room: S403A



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

Participants

Robert Jeraj, PHD, Madison, WI (Moderator) Founder, AIQ Services

LEARNING OBJECTIVES

1. To learn about use of imaging in management of H&N 2. To learn about imaging for target definition in H&N 3. To learn about imaging for treatment response assessment in H&N $\!\!$

Sub-Events

RC122A Anatomical Imaging for Personalized Medicine in the Head and Neck

Participants Emilie Soisson, PhD, Burlington, VT (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Describe the evolution of adaptive radiotherapy and relevant technological advances as they pertain to head and neck radiotherapy 2. Understand the clinical rational for of plan adaptation in the head and neck patient population 3. Describe possible routes to clinical implementation 4. Discuss risks associated with adaptive planning workflows and appropriate quality assurance

ABSTRACT

This session will focus on the practical implementation of adaptive radiotherapy for head and neck cancer. Although the concept of adaptive radiation therapy (ART) has been around now for more than two decades, routine plan adaptation has not become standard practice in the management of head and neck cancer despite huge technological advances in imaging, image registration software, and dose calculation speed. The remaining challenges in implementing ART for head and neck cancer in 2015 as well as an update of the demonstrated clinical need will be discussed. Features of successful adaptive radiotherapy implementations will be highlighted as well as a summary of useful clinical tools and required quality assurance.

RC122B Functional Imaging for Targeting and Adaptation in the Head and Neck

Participants Robert Jeraj, PHD, Madison, WI (*Presenter*) Founder, AIQ Services

LEARNING OBJECTIVES

1) To learn how molecular imaging adds value in diagnosis/staging. 2) To learn how molecular imaging adds value in target definition. 3) To learn how molecular imaging adds value in treatment response assessment.







RC123

Molecular Imaging Mini-Course: Basics of Molecular Imaging

Sunday, Nov. 26 2:00PM - 3:30PM Room: S502AB

CT MI NM PH

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

LEARNING OBJECTIVES

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC123A Developing Molecular Imaging Agents

Participants

Martin G. Pomper, MD, PhD, Baltimore, MD (*Presenter*) Researcher, Progenics Pharmaceuticals, Inc; License agreement, Progenics Pharmaceuticals, Inc; Researcher, Advanced Accelerator Applications SA; License agreement, Advanced Accelerator Applications SA; Co-founder, Cancer Targeting Systems, Inc; Board Member, Cancer Targeting Systems, Inc; Researcher, Juno Therapeutics, Inc; Licensiing agreement, Juno Therapeutics, Inc; Co-founder, Neurly; Board Member, Neurly; Co-founder, Theraly Pharmaceuticals, Inc; ;

LEARNING OBJECTIVES

1) Describe the ideal properties of a molecular imaging agent and molecular target. 2) Describe the in vitro and in vivo validation of the molecular imaging agent. 3) Describe specific examples of successful molecular imaging agents.

RC123B Instrumentation (PET and CT) and Image Reconstruction

Participants

John Sunderland, PhD, Iowa City, IA (Presenter) Research Grant, Siemens AG; Research Grant, General Electric Company

LEARNING OBJECTIVES

1) Identify the primary design components of a modern PET/CT system. 2) Design and implement a PET/CT quality control program to assure high quality and quantitatively accurate clinical imaging. 3) Describe commonly used PET reconstruction algorithms and the practical impact of reconstruction parameters upon image quality and quantitation.

RC123C Basic Clinical Applications

Participants

Hubert J. Vesselle, MD, PhD, Seattle, WA (Presenter) Consultant, MIM Software Inc

LEARNING OBJECTIVES

1) Describe a systematic approach to hybrid imaging (PET/CT and SPECT/CT) and its advantages. 2) Illustrate this approach through selected clinical examples.







Around the World in 80 Minutes: Current Global Campaigns for Informed Use of Radiation in Medical Imaging

Sunday, Nov. 26 2:00PM - 3:30PM Room: S403B

sq

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

Participants

Donald P. Frush, MD, Durham, NC (*Moderator*) Nothing to Disclose William W. Mayo-Smith, MD, Boston, MA (*Moderator*) Author with royalties, Reed Elsevier; Michael G. Kawooya, MBBCh, PhD, Kampala, Uganda (*Presenter*) Nothing to Disclose Boudjema Mansouri, MD, Algiers, Algeria (*Presenter*) Nothing to Disclose David A. Koff, MD,FRCPC, Hamilton, ON (*Presenter*) Stockholder, Real Time Medical, Inc; Spouse, President, Real Time Medical, Inc Guy Frija, MD, Paris, France (*Presenter*) Nothing to Disclose Donald P. Frush, MD, Durham, NC (*Presenter*) Nothing to Disclose William W. Mayo-Smith, MD, Boston, MA (*Presenter*) Author with royalties, Reed Elsevier; Kanako K. Kumamaru, MD, PhD, Tokyo, Japan (*Presenter*) Nothing to Disclose Pablo Soffia, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

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boudjema.mansouri@gmail.com

LEARNING OBJECTIVES

1) Learn unique aspects of each campaign/organization. 2) Understand successes of each campaign/organization. 3) Be able to discuss current efforts and opportunities. 4) Be able to identify challenges. 5) Be familiar with current imaging guidelines and decision support.

ABSTRACT

This refresher course is organized by Image Gently and Image Wisely and is a showcase for international organizations that share similar missions for informed used of ionizing radiation in medical imaging and image-guided procedures. This will be the first time all major global campaigns, also aligned through the International Society of Radiology's Quality and Safety Alliance (ISR QSA), will be together presenting at the same venue. Each campaign leader will discuss the course objectives relevant to their region/country.







Radiomics Mini-Course: Promise and Challenges

Sunday, Nov. 26 2:00PM - 3:30PM Room: N226



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

Participants

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

Michael F. McNitt-Gray, PhD, Los Angeles, CA (Coordinator) Institutional research agreement, Siemens AG; ;;;;

For information about this presentation, contact:

snapel@stanford.edu

Sub-Events

RC125A An Overview of Radiomics

Participants

Maryellen L. Giger, PhD, Chicago, IL (*Presenter*) Stockholder, Hologic, Inc; Stockholder, Quantitative Insights, Inc; Shareholder, QView Medical, Inc; Co-founder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Medical Systems Corporation

For information about this presentation, contact:

m-giger@uchicago.edu

LEARNING OBJECTIVES

1) Appreciate the motivation and scientific premise of quantitative image analysis (radiomics). 2) Learn about the role of computerextracted hand-crafted radiomics and deep learning in quantitative radiomics. 3) Understand the role of quantitative radiomics in multi-omics cancer discovery studies and development of predictive models for precision medicine.

RC125B From Radiomics to Radiogenomics

Participants

Hugo Aerts, PhD, Boston, MA (Presenter) Stockholder, Sphera Inc

For information about this presentation, contact:

Hugo_Aerts@dfci.harvard.edu

LEARNING OBJECTIVES

1) Learn about the motivation and methodology of image-based phenotyping. 2) Learn about scientific radiomic studies investigating engineered and deep learning based methods for image phenotyping. 3) Learn about the potential role of radiologic AI with other -omics data within precision medicine.

RC125C Challenges for Radiomics and Radiogenomics

Participants Karen Drukker, PhD, Chicago, IL (*Presenter*) Royalties, Hologic, Inc

For information about this presentation, contact:

kdrukker@uchicago.edu

LEARNING OBJECTIVES

1) Gain an understanding of the pitfalls along the radiomics/radiogenomics (imaging genomics) pipeline. 2) Appreciate the crucial role of statistics in the design and evaluation of radiomics and radiogenomics studies. 3) Learn about the special challenges associated with big data.

ABSTRACT

1. Introduction Basic statistical concepts Association, correlation, and causality Know when your numbers are significant 2. Reproducibility (or lack thereof) Replication studies The extent of the problem Curse of dimensionality, overfitting, multiple hypothesis testing Sample size, P-value variability 3. "Big Data" "Big data" vs. "medium data" vs. "small data" Training and testing data sets Harmonization



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RC127

Value of Imaging

Sunday, Nov. 26 2:00PM - 3:30PM Room: S404AB

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

FDA Discussions may include off-label uses.

Participants

Saurabh Jha, MD, Philadelphia, PA (Moderator) Speakers Bureau, Toshiba Medical Systems Corporation

LEARNING OBJECTIVES

1) Understand the economics of imaging and information. 2) Understand how new technology is regulated. 3) Appreciate new frontiers in measuring quality.

ABSTRACT

This session will explore the broader shores of economics as they apply to imaging. Specifically, the attendees will be introduced to the economics of information, value of information, the tensions in valuing technology using net benefits, quality-adjusted life years, and randomized control trials. The session will also address elements of law, regulations and imaging, and a novel way of measuring quality.

Sub-Events

RC127A Economics of Imaging (1)

Participants

Saurabh Jha, MD, Philadelphia, PA (Presenter) Speakers Bureau, Toshiba Medical Systems Corporation

LEARNING OBJECTIVES

1) Understand the basics of information theory. 2) Appreciate the purpose of information in general and medical information in particular. 3) Introduction to Bayesian logic, conditional independence. 4) Appreciation of threshold basis of decision making. 5) Tensions between the various purposes of information.

RC127B Measuring Quality - It's Possible

Participants

Jeffrey D. Robinson, MD, MBA, Seattle, WA (Presenter) Consultant, HealthHelp, LLC; President, Cleareview, Inc;

LEARNING OBJECTIVES

1) Appreciate what quality means from different perspectives 2) Understand factors that affect the judgement of accuracy 3) Recognize the value of blind reviews to measure quality.

ABSTRACT

How can we measure quality when we cannot even agree on what to measure, much less how to measure it? While most would agree that diagnostic accuracy is a prime component of quality in radiology, currently used assessments of accuracy suffer from many types of bias. This talk will outline two different unbiased approaches to measure accuracy.

RC127C Economics of Imaging (2)

Participants

Saurabh Jha, MD, Philadelphia, PA (Presenter) Speakers Bureau, Toshiba Medical Systems Corporation

LEARNING OBJECTIVES

1) Understand how medical imaging is valued. 2) Understand quality adjusted life years, net health benefits and value of perfect information. 3) Understand how we quantify uncertainty. 4) Appreciate role of randomized controlled trials in imaging. 5) Appreciate the role of imaging in subtractive medicine - the case of the calcium scan.

RC127D Regulations and New Technology

Participants

H. Benjamin Harvey, MD, JD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the current landscape of government regulation as it pertains to radiology-based technologies. 2) Assess the potential impact of efforts to loosen FDA regulations on innovation, healthcare costs, and patient safety. 3) Evaluate current regulatory challenges with respect to clinical decision support and artificial intelligence. 4) Understand the role of "off-label" device usage in hastening medical progress as well as the potential regulatory pitfalls.







MR Imaging of the Female Pelvis for Planning Fertility Preservation Therapy, and the Appearance of the Pelvis Post Therapy (An Interactive Session)

Sunday, Nov. 26 2:00PM - 3:30PM Room: S402AB

GU MR

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

Participants

Hero K. Hussain, MD, Ann Arbor, MI (Moderator) Nothing to Disclose

Sub-Events

RC129A MR Imaging for Planning Fertility Preservation Therapy in Gynecologic Malignancies

Participants Katherine E. Maturen, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kmaturen@umich.edu

LEARNING OBJECTIVES

1) Appreciate low risk imaging features of adnexal masses, supporting potential management with surveillance, cystectomy, or oophorectomy rather than complete surgical staging. 2) Recognize imaging features of non myoinvasive endometrial cancer, for both diagnosis and surveillance if managed conservatively. 3) Understand imaging guidelines supporting surgical choice of trachelectomy in cervical cancer.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Katherine E. Maturen, MD - 2014 Honored Educator

RC129B MR Imaging for Planning Fertility Preservation Therapy in Benign Gynecologic Diseases

Participants

Jessica B. Robbins, MD, Madison, WI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the spectrum of benign uterine and adnexal pathology. 2) Describe the fertility sparing procedures that can be performed for such conditions. 3) Explain the role of MRI in planning for these procedures.

RC129C MR Imaging of the Pelvis Post Therapy of Benign Gynecologic Conditions

Participants

Susan M. Ascher, MD, Washington, DC (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Improve knowledge of therapies for symptomatic gynecologic conditions with a focus on leiomyomas treated with uterine artery embolization (UAE). 2) Provide an efficient protocol for MRI surveillance post treatment of benign gynecologic conditions. 3) Improve knowledge of the MRI appearance of the female pelvis post treatment to include features of success and failure.

RC129D MR Imaging of the Pelvis Post Therapy of Gynecologic Malignancies

Participants Liina Poder, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

liina.poder@ucsf.edu

LEARNING OBJECTIVES

1) To become familiar with most current various treatment options for gynecologic malignancies as well as expected imaging appearance of post treatment female pelvis. 2) To understand the expected and some unexpected imaging appearances as well as common pitfalls.







RC131

US for Thyroid Cancer: Diagnosis, Surveillance, and Treatment

Sunday, Nov. 26 2:00PM - 3:30PM Room: E451A



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

Participants

Jill E. Langer, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose Kathryn A. Robinson, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose Sheila Sheth, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

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

ABSTRACT

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







RC132

How to Avoid Failure: Qualities of a Successful Leader

Sunday, Nov. 26 2:00PM - 3:30PM Room: E350

LM

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

LEARNING OBJECTIVES

1) Develop an understanding of the essential traits and skills required for a leader to be successful, ie traits and states. 2) Develop an understanding of the common errors made by leaders in academic and private practices enabling the attendee to obtain the ? learnings' without the 'lumps. 3) Acquire the skills of succession planning needed to ensure that the success of your organization is sustainable over time and leadership transitions. (This course is part of the Leadership Track)

Sub-Events

RC132A Life Lessons for Successful Leadership

Participants

James A. Brink, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the importance of emotional intelligence in for successful leadership. 2) To explore the relationship between communication style and the effectiveness of leadership. 3) To consider techniques that elevate the level of respect and trust in an organization.

RC132B Keys to Avoid Failure: Key Qualities of a Successful Leader

Participants

Jonathan S. Lewin, MD, Atlanta, GA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title. (This course is part of the Leadership Track)

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Jonathan S. Lewin, MD - 2012 Honored Educator

RC132C Leadership

Participants N. Reed Dunnick, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize historical examples of leaders, in addition to how you can recognize and emulate their favorable characteristics that draw you to their leadership attributes. 2) Understand an overview of leadership references, where and how to access the same, how the related body of knowledge has evolved, and current perspectives concerning leaders and leadership. (This course is part of the Leadership Track)







RC150

MR Imaging-guided Breast Biopsy (Hands-on)

Sunday, Nov. 26 2:00PM - 3:30PM Room: E260



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

Participants

Amy L. Kerger, DO, Columbus, OH (Presenter) Nothing to Disclose Rifat A. Wahab, DO, Cincinnati, OH (Presenter) Nothing to Disclose Vandana M. Dialani, MD, Boston, MA (Presenter) Nothing to Disclose Deepa Sheth, MD, Chicago, IL (Presenter) Nothing to Disclose Lara D. Richmond, MD, Toronto, ON (Presenter) Nothing to Disclose Gary J. Whitman, MD, Houston, TX (Presenter) Book contract, Cambridge University Press Kirti M. Kulkarni, MD, Chicago, IL (Presenter) Nothing to Disclose Jill J. Schieda, MD, Cleveland, OH (Presenter) Nothing to Disclose Jiyon Lee, MD, New York, NY (Presenter) Nothing to Disclose Mitva J. Patel, MD, Columbus, OH (Presenter) Nothing to Disclose Amado B. del Rosario, DO, Columbus, OH (Presenter) Nothing to Disclose Karla A. Sepulveda, MD, Houston, TX (Presenter) Nothing to Disclose Jamie G. Giesbrandt, MD, Albuquerque, NM (Presenter) Nothing to Disclose Wendi A. Owen, MD, Saint Louis, MO (Presenter) Nothing to Disclose Laurie R. Margolies, MD, New York, NY (Presenter) Nothing to Disclose Mitra Noroozian, MD, Ann Arbor, MI (Presenter) Nothing to Disclose Jeffrey R. Hawley, MD, Columbus, OH (Presenter) Nothing to Disclose Nikki S. Ariaratnam, MD, Voorhees, NJ (Presenter) Nothing to Disclose Su-Ju Lee, MD, Cincinnati, OH (Presenter) Spouse, Stockholder, General Electric Company; Spouse, Stockholder, Siemens AG Mai A. Elezaby, MD, Madison, WI (Presenter) Nothing to Disclose Anika N. Watson, MD, New York, NY (Presenter) Nothing to Disclose Alena Levit, MD, Rochester, NY (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) Apply positioning and other techniques to challenging combinations of lesion location and patient anatomy for successful MR-guided biopsy.

ABSTRACT

This course is intended to provide basic didactic instruction and hands-on experience for MR-guided breast biopsy. Because of the established role of breast MRI in the evaluation of breast cancer through screening and staging, there is a proven need for MR-guided biopsy of the abnormalities that can only be identified at MRI. This course will be devoted to the understanding and identification of: 1) appropriate patient selection 2) optimal positioning for biopsy 3) target selection and confirmation 4) various biopsy technologies and techniques 5) potential problems and pitfalls and 6) practice audits. Participants will spend 30 minutes in didactic instruction followed by 60 minutes practicing MR-guided biopsy using provided phantoms. Various combinations of full size state-of-the-art breast MRI coils, biopsy localization equipment and needles from multiple different vendors will be available for hands-on practice. Some stations will have monitors loaded with targeting software. Expert breast imagers from around the world will be at each of 10 stations to provide live coaching, tips, techniques and advice.







RC152

US-guided Interventional Breast Procedures (Hands-on)

Sunday, Nov. 26 2:00PM - 3:30PM Room: E264



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

Participants

Karen S. Johnson, MD, Durham, NC (Presenter) Nothing to Disclose Jocelyn A. Rapelyea, MD, Washington, DC (Presenter) Speakers Bureau, General Electric Company; Shambhavi Venkataraman, MD, Boston, MA (Presenter) Nothing to Disclose Angelique C. Floerke, MD, Chicago, IL (Presenter) Consultant, Becton, Dickinson and Company Anita K. Mehta, MD, MSc, Washington DC, DC (Presenter) Nothing to Disclose Nicole S. Lewis, MD, Washington, DC (*Presenter*) Nothing to Disclose Kathleen R. Gundry, MD, Atlanta, GA (*Presenter*) Nothing to Disclose Michael N. Linver, MD, Albuquerque, NM (Presenter) Scientific Advisory Board, Hologic, Inc; Scientific Advisory Board, Real Imaging Ltd; Scientific Advisory Board, Seno Medical Instruments, Inc Christina G. Marks, MD, Saint Louis, MO (Presenter) Nothing to Disclose Tilden L. Childs III, MD, Fort Worth, TX (Presenter) Stockholder, Pfizer Inc Evguenia J. Karimova, MD, Memphis, TN (Presenter) Nothing to Disclose Caroline M. Ling, MD, Darby, PA (Presenter) Nothing to Disclose Sora C. Yoon, MD, Durham, NC (Presenter) Nothing to Disclose Connie E. Kim, MD, Durham, NC (Presenter) Spouse, Consultant, ClarVista Medical, Inc; Spouse, Royalties, Leica Biosystems Nussloch GmbH; Spouse, Intellectual property, Leica Biosystems Nussloch GmbH Mary S. Soo, MD, Durham, NC (Presenter) Nothing to Disclose Margaret M. Szabunio, MD, Lexington, KY (Presenter) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe the equipment needed for ultrasound guided interventional breast procedures. 2) Review the basic principles of ultrasound guidance and performance of minimally invasive breast procedures. 3) Practice hands-on technique for ultrasound guided breast interventional procedures.

ABSTRACT

This course is intended to familiarize the participant with equipment and techniques in the application of US guided breast biopsy and needle localization. Participants will have both basic didactic instruction and hands-on opportunity to practice biopsy techniques on tissue models with sonographic guidance. The course will focus on the understanding and identification of: 1) optimal positioning for biopsy 2) imaging of adequate sampling confirmation 3) various biopsy technologies and techniques 4) potential problems and pitfalls







Deep Learning & Machine Intelligence in Radiology

Sunday, Nov. 26 2:00PM - 3:30PM Room: E450A

IN

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

Participants

Paul J. Chang, MD, Chicago, IL (*Moderator*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Advisory Board, Bayer AG; Advisory Board, Aidoc Ltd; Advisory Board, McCoy

For information about this presentation, contact:

pchang@radiology.bsd.uchicago.edu

Sub-Events

RC153A An Introduction to Deep Learning & Machine Intelligence: What the Radiologist Needs to Know

Participants

Dimitrios Mavroeidis, Eindhoven, Netherlands (Presenter) Research, Koninklijke Philips NV

For information about this presentation, contact:

dimitrios.mavroeidis@philips.com

LEARNING OBJECTIVES

1) Understand the principles of knowledge extraction from data (Machine Learning). 2) Understand main intuitions behind deep machine learning models (Deep Learning). 3) Understand how Deep Learning can be applied to medical image analysis and the main challenges associated to the application of Deep Learning in this domain.

RC153B Deep Learning and Machine Intelligence in Radiology: A Reality Check

Participants

Paul J. Chang, MD, Chicago, IL (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Advisory Board, Bayer AG; Advisory Board, Aidoc Ltd; Advisory Board, McCoy

LEARNING OBJECTIVES

1) A "realistic" perspective on how deep learning and machine intelligence can add value to radiology will be discussed. 2) The significant challenges with respect to practical implementation of deep learning/machine intelligence offerings by existing radiology workflow and existing IT infrastructure will be reviewed. 3) Strategies for preparing the radiology department and IT for deep learning/machine intelligence will be discussed.

ABSTRACT

Current and near future requirements and constraints will require radiology practices to continuously improve and demonstrate the value they add to the healthcare enterprise. Merely 'managing the practice' will not be sufficient; groups will be required to compete in an environment where the goal will be measurable improvements in efficiency, productivity, quality, and safety. There has been great interest (as well as fear and hype) regarding the application of deep learning and other machine intelligence approaches to help improve the radiology value proposition. This session will attempt to provide a "reality check" on how these potentially promising technologies might be used by radiology and the significant challenges involved. Topics that will be covered include: • How can we best apply deep learning/machine intelligence to add "true value?" • How do we confidently validate the performance of these technologies? • How can our existing IT systems "feed and consume" these technologies efficiently and at scale? • How can we best harmonize the human radiologist with these machine agents?

RC153C Deep Learning: How to Get Started

Participants

Abdul Hamid Halabi, Santa Clara, CA (Presenter) Employee, NVIDIA Corporation

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ahalabi@nvidia.com







RC154

How Did I Miss That? Perceptual and Attentional Roots of Medical Errors

Sunday, Nov. 26 2:00PM - 3:30PM Room: E450B



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 0

Participants

Jeremy M. Wolfe, PhD, Cambridge, MA (Presenter) Research collaboration, IBM Corporation;

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jwolfe@partners.org

LEARNING OBJECTIVES

1) Learn basic perceptual limitations on the analysis of medical images and potential solutions. 2) Understand attentional limits on visual search (having seen a series of examples) and how these limits can impact search in radiologic images. 3) Learn about "cognitive heuristics," and how these mental shortcuts can provide benefits as well as lead to medical errors. 4) Learn how technological changes could help radiologists to deal with these perceptual, attentional, and cognitive issues.







RCA12

3D Printing Hands-on with Open Source Software Introduction (Hands-on)

Sunday, Nov. 26 2:00PM - 3:30PM Room: S401AB

IN

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

Participants

Michael W. Itagaki, MD, MBA, Lynnwood, WA (*Presenter*) Owner, Embodi3D, LLC Beth A. Ripley, MD, PhD, Seattle, WA (*Presenter*) Nothing to Disclose Tatiana Kelil, MD, San Francisco, CA (*Presenter*) Nothing to Disclose Carissa M. White, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose Dmitry Levin, Seattle, WA (*Presenter*) Nothing to Disclose Steve D. Pieper, PhD, Cambridge, MA (*Presenter*) CEO, Isomics, Inc; Employee, Isomics, Inc; Owner, Isomics, Inc; Research collaboration, Siemens AG; Research collaboration, Novartis AG; Consultant, Harmonus; Research collaboration, gigmade Anish Ghodadra, MD, New Haven, CT (*Presenter*) Consultant, PECA Labs; Advisory Board, axial3D Limited

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) To learn about basic 3D printing technologies and file formats used in 3D printing. 2) To learn how to segment a medical imaging scan with free and open-source software and export that anatomy of interest into a digital 3D printable model. 3) To perform basic customizations to the digital 3D printable model with smoothing, text, cuts, and sculpting prior to physical creation with a 3D printer.

ABSTRACT

'3D printing' refers to fabrication of a physical object from a digital file with layer-by-layer deposition instead of conventional machining, and allows for creation of complex geometries, including anatomical objects derived from medical scans. 3D printing is increasingly used in medicine for surgical planning, education, and device testing. The purpose of this hands-on course is to teach the learner to convert a standard Digital Imaging and Communications in Medicine (DICOM) data set from a medical scan into a physical 3D printed model through a series of simple steps using free and open-source software. Basic methods of 3D printing will be reviewed. Initial steps include viewing and segmenting the imaging scan with 3D Slicer, an open-source software package. The anatomy will then be exported into stereolithography (STL) file format, the standard engineering format that 3D printers use. Then, further editing and manipulation such as smoothing, cutting, and applying text will be demonstrated using MeshMixer and Blender, both free software programs. Methods described will work with Windows, Macintosh, and Linux computers. The learner will be given access to comprehensive resources for self-study before and after the meeting, including an extensive training manual and online video tutorials.

Active Handout: Michael Ward Itagaki

http://abstract.rsna.org/uploads/2017/14003456/Active RCA12.pdf

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RCB12

Making the Most of Google Docs: Docs, Slides, Forms, and Sheets (Hands-on)

Sunday, Nov. 26 2:00PM - 3:30PM Room: S401CD

IN

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

Participants

Marc D. Kohli, MD, San Francisco, CA (*Moderator*) Nothing to Disclose Thomas W. Loehfelm, MD, PhD, Atlanta, GA (*Presenter*) Nothing to Disclose Aaron P. Kamer, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose Ross W. Filice, MD, Chevy Chase, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the benefits and drawbacks of using Google tools for collaborative editing. 2) Explain issues related to storing protected health information in Google Drive. 3) Demonstrate the ability to use the Google productivity applications for collaboration on document, spreadsheet, online form and presentation creation.

ABSTRACT

Note: Attendees should have or create a Google account prior to coming to the session. In today's busy environment, we need tools to work smarter, not harder. Google's suite of productivity applications provides a platform for collaboration that can be used across and within institutions to produce documents and presentations and to obtain and work-up data with ease. However, with increased sharing, security concerns need to be addressed. At the end of the session, learners should be able to demonstrate creating, sharing, and editing a document as a group.







RCC12

Will MACRA and MIPS Kill Your Practice?

Sunday, Nov. 26 2:00PM - 3:30PM Room: S501ABC



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 0

Participants

David C. Levin, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose David C. Levin, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose Ezequiel Silva III, MD, San Antonio, TX (*Presenter*) Nothing to Disclose J. Raymond Geis, MD, Fort Collins, CO (*Presenter*) Advisor, Nuance Communications, Inc

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LEARNING OBJECTIVES

1) Understand how the Medicare Access and CHIP Reauthorization Act (MACRA) and Merit-Based Incentive Payment System (MIPS) will affect your radiology practice. 2) Learn about new changes in the government's value based care. 3) Discover how.data registries will help you comply with MIPS. 4) Find out which MIPS metrics are most applicable to radiologists.







PS12

Sunday Afternoon Plenary Session

Sunday, Nov. 26 4:00PM - 5:45PM Room: Arie Crown Theater



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

Participants

Richard L. Ehman, MD, Rochester, MN (Presenter) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

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Sub-Events

PS12A Report of the RSNA Research and Education Foundation

Participants

N. Reed Dunnick, MD, Ann Arbor, MI (Presenter) Nothing to Disclose

Abstract

Since 1984, your RSNA Research & Education (R&E) Foundation has supported more than 1,200 investigators. An R&E Grant can inspire a career in research and help develop the leaders of tomorrow's radiology. The mission of the RSNA R&E Foundation is to improve patient care by supporting research and education in radiology and related scientific disciplines by funding grants and awards to individuals and institutions that will advance radiologic research, education and practice. Generous donations from individuals, private practice groups and corporations ensure that work continues year after year. Foundation grant recipients innovate solutions and methodologies to solve challenges facing radiology today, from discovering new MRI techniques for breast cancer imaging to using data integration to gain insights into the developing brain. In 2017, the R&E Foundation awarded more than \$4 million for the second consecutive year, funding researchers at 50 institutions. At a 30 percent funding rate, the Foundation primes the pump of radiology research by supporting early-career investigators. Grant recipients report earning an additional \$40 for every dollar awarded by the Foundation. The R&E Foundation launched its Campaign in 2014 to raise \$17.5 million dollars and ensure a continuity of funding for these critical projects. Invest in the Foundation today to demonstrate your commitment to the future of your specialty. The Inspire-Innovate-Invest Campaign ends this year, and we need your help to reach our goal. As we all strive to "Explore. Invent. Transform." during this annual meeting, please take time to visit the R&E Foundation Booth, located in Lakeside Center East, Level 3. There you can discover the 2017 grant recipients and their innovative projects and learn how you can support the Foundation through our Campaign.

PS12B Image Interpretation Session

Participants

Desiree E. Morgan, MD, Birmingham, AL (*Presenter*) Research Grant, General Electric Company John Eng, MD, Cockeysville, MD (*Presenter*) Nothing to Disclose James C. Anderson, MD, Portland, OR (*Presenter*) Nothing to Disclose Marta E. Heilbrun, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose Eva Llopis, MD, Valencia, Spain (*Presenter*) Nothing to Disclose Angelisa M. Paladin, MD, Seattle, WA (*Presenter*) Nothing to Disclose Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose

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.

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RCA13

Rectal MRI (Hands-on)

Sunday, Nov. 26 4:00PM - 5:30PM Room: S401AB



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

Participants

David H. Kim, MD, Middleton, WI (*Presenter*) Co-founder, VirtuoCTC, LLC; Shareholder, Cellectar Biosciences, Inc; Shareholder, Elucent Medical;

Mukesh G. Harisinghani, MD, Boston, MA (*Presenter*) Nothing to Disclose Marc J. Gollub, MD, New York, NY (*Presenter*) Nothing to Disclose Courtney C. Moreno, MD, Suwanee, GA (*Presenter*) Nothing to Disclose Raj M. Paspulati, MD, Cleveland, OH (*Presenter*) Nothing to Disclose Gaiane M. Rauch, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose Zahra Kassam, MD, London, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Critically evaluate the primary tumor to accurately place in the appropriate T category. 2) Apply specific criteria to determine regional lymph node status. 3) Recognize relevant anatomic landmarks used in Rectal MRI cancer staging to help determine management.

ABSTRACT

This workshop will be led by members of the Society of Abdominal Radiology Rectal Cancer Disease Focused Panel. This group helps set the interpretation standards for rectal cancer MRI in the United States. In this 1.5 hour Hands-on Workshop, the participants will have the opportunity to review a number of rectal staging MRI cases on stand-alone computers or on a personal mobile device. The selected cases are intended to give a broad overview of the common issues encountered in rectal cancer staging, including appropriately categorizing the correct T category of the tumor as well as determining regional lymph node status. The relevant anatomic relationships of the tumor with adjacent structures for surgical and potential neoadjuvant options will be emphasized. An interactive platform will allow participants to see overall class performance for questions posed by the expert reviewer. Each case will be reviewed after a short interval to allow a participant to form an opinion prior to the expert review. This workshop is intended to give a practical, hands-on approach to rectal cancer staging by MRI.







RCB13

Getting Stuff Done: A Hands-on Technology Workshop to Enhance Personal Productivity (Hands-on)

Sunday, Nov. 26 4:00PM - 5:30PM Room: S401CD

IN

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

Participants

Matthew B. Morgan, MD, Sandy, UT (*Presenter*) Consultant, Reed Elsevier Puneet Bhargava, MD, Seattle, WA (*Presenter*) Editor, Reed Elsevier Dushyant V. Sahani, MD, Boston, MA (*Presenter*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc

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LEARNING OBJECTIVES

Introduce the concept of "Getting Things Done.' 2) Learn the concepts of Inbox Zero and other email management techniques.
 Using tools such as note-taking applications, citation and password managers.

Honored Educators

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RCC13

3D Printing Introduction

Sunday, Nov. 26 4:00PM - 5:30PM Room: S501ABC

IN

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

Sub-Events

RCC13A Implementing 3D Printing Into a Clinical Practice

Participants

Jonathan M. Morris, MD, Rochester, MN (Presenter) Nothing to Disclose

RCC13B 3D Printing in Clinical Sciences

Participants

Ciprian Ionita, PhD, Buffalo, NY (*Presenter*) Grant, Toshiba Medical Systems Corporation; Grant, Stratasys, Inc; Grant, Vader Systems; Grant, Medtronic plc;

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LEARNING OBJECTIVES

1) Describe methods to create 3D printed patient specific vascular phantoms based on 3D angiography. 2) To demonstrate how patient specific 3D printed vascular phantoms can be used for medical software development and validation. 3) To demonstrate the use of 3D printing in a clinical setting for endovascular treatment planning.

ABSTRACT

Patient specific vascular phantoms manufactured using 3D printing have provided the medical community with a new set of tools for device testing, software validation and endovascular treatment planning. Most of the currently used vascular phantoms are made from one material and they are a simplification of the patient anatomy. They model one main artery, rarely included branching arteries and the arterial wall mechanical properties are ignored. Presence of pathologies such as atherosclerotic plaques or surrounding anatomical structures is practically inexistent. These simple patient specific geometries are used to evaluate endovascular devices or validate software but they lack the true clinical situations test, such as device navigation in complex vascular systems, modeling of challenging pathologies or mimicking of physiological aspects of the blood flow. 3D printing using digital materials could solve all these challenges. In this lecture we will present how to design complex vascular phantoms which includes significant distal vasculature and vascular lesions such as atherosclerotic plaques and aneurysms. We will show various applications of the patient specific vascular phantoms for treatment planning of vascular diseases such as abdominal aortic aneurysms with the Fenestrated Endo Vascular Aortic Repair device. We will show thow this approach resulted in significant changes of the treatment plan indicating that the 3D printed phantoms could have significant impact on complex procedural approaches.

RCC13C 3D Printing from MRI Data

Participants Nicole Wake, MS, New York, NY (*Presenter*) In-kind support, Stratasys, Ltd

For information about this presentation, contact:

nicole.wake@med.nyu.edu

LEARNING OBJECTIVES

1) Explain the basics of 3D printing from MRI data. 2) Describe MR sequences used for the generation of 3D printed models. 3) Discuss segmentation techniques used to work up MRI data for 3D printing. 4) Specify the limitations of current technology.

ABSTRACT

3D medical models can, in theory, be printed from any volumetric image dataset with sufficient contrast to differentiate tissues. CT images are generally used to create 3D printed models due to the relative ease of image post-processing. However, MRI is an attractive alternative, since it offers superior soft-tissue characterization, flexible image contrast mechanisms, and avoids the use of ionizing radiation or iodinated contrast. This presentation will provide an overview of 3D printing from MRI data. Specifically, MR sequences and basic segmentation principles for the generation of 3D printed models will be described. Case examples will be reviewed to demonstrate how 3D models can be created from MRI data.

RCC13D How to Set Up a 3D Printing Lab

Participants Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose Share our process from design to implementation. 2) Design detail: Nuts and bolts of hardware, software, space and personnel.
 Explain how a 3D lab can fit into the radiology vision and the institutional strategic plan. 4) Illustrate how a medical 3D lab can be incorporated into daily practice. 5) Share our 11 yr experiences in the 3D lab.